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Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of Electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.
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VOL. XIV. NEW YORK, OCT. 12, 1889. No. 15.

Dynamo and Motor Regulation. IN this issue we publish an interesting article by Dr. Leonard Paget, describing very fully the various new and ingenious devices invented by M. Lahmeyer for the regulation of dynamo electric machines and motors. They are based on the novel principle of introducing a separate variable E. M. F. instead of the usual varying resistance devices. Although they somewhat complicate the construction of the machines, there is no doubt considerable field for the introduction of the methods.

D'Arsonval on Electro-Physiology. WE present this week the conclusion of M. D'Arsonval's communication to the Paris conference on electro-physiology. It is very interesting in regard to the effects shown on living recipients and the precautions to be adopted. M. D'Arsonval's opinion is that mean, equal-pressure, alternating currents are more dangerous than continuous. He also points out the fact that in the organs of electric fish the electricity is not already formed, but that it is produced when the organs enter on their functions at the will of the animal.

"Cranks" and Electricity. MR. FOREE BAIN gives a very amusing description in our columns this week of his experience with "cranks" who believe electricity to be able to do everything, and who want him to build apparatus for them for some wonderful purpose. As Mr. Bain remarks, sometimes these people have a good idea, but even then he has to do the practical inventing. There can be no question that the popular imagination looks with confidence to the appearance of an electrical method for doing everything, and as this has so many advantages in the way of encouraging new ideas of real worth, we can forgive the cranks who propound wild schemes occasionally.

A Long Incandescent Circuit. IN reference to our recent editorial comment on the long distance incandescent lighting at Ottawa, Ill., the Heisler Company inform us that the circuit there is actually 45 miles in length! They believe this, with reason, to be the longest incandescent circuit in the world, and they question whether it is approached by an arc circuit. If our readers know of anything that at all approximates to this, we shall be glad to hear from them. It is certainly a most remarkable instance of flexibility of system and of the delivery of electrical current at an extremely remote point. As we hinted in our note on the subject, arc light electricians must look to their laurels.

"Therm" as a Unit. AT the Paris International Electrical Conference we find several new electrical terms coined and propositions also made to change others. Thus the unit "therm" was put forward in place of the "calorie," but did not find general approbation. The question then arose, Why employ either, taking instead the joule as the thermal unit? Prof. G. Forbes and W. H. Preece propose in their paper read before the British Association, which we publish on another page, to form a C. G. S. thermometric scale, each division representing the expenditure of one joule per gramme of water. Although the new scale is very ingenious, it may be as well to go slowly on its adoption, as we already have degrees Fahrenheit, Centigrade and Reaumur, and another would not tend to simplify matters much.

A Pioneer Dynamo Builder. WE publish to-day in our series of ELECTRICAL WORLD PORTRAITS the biography of Mr. W. Hochhausen, who ranks among the very earliest constructors of dynamo-electric machinery in this country, and who, despite his reserved and retiring disposition, has been foremost in important inventions in this field, winning a reputation that probably would be far wider and higher than it is, were the man himself better known. Mr. Hochhausen is a good representative of the large body of German electricians who have brought their trained minds and skilled hands to this country, and have done so much by their hard work in inventing, designing and engineering to promote the prosperity of electrical arts in America.

The Hertz Experiments. WE publish this week an account of some of Prof. H. Hertz's experiments on the propagation of electric waves through wires. They are based on the effect of a current of high frequency penetrating but a short distance into the interior of the conductor, due to the greater opposition of induction at the interior than at the circumference of the conductor. The opinion of Heaviside and Poynting, that the electric force which determines the current is not propagated in the conductor itself, but enters from the outside and comparatively slowly spreads itself, is adequately borne out. These experiments are remarkable for the new light which they throw on the effects of induction and current generation, and on the modern etherial theory of electricity.

The Drawbaugh Tradition. DURING the past week or two there has been a remarkable revival in the papers of all the talk about Drawbaugh and his invention of the telephone. Columns upon columns are devoted to the repetition of old stories about his wonderful inventive genius, and about the manner in which he and the good folk at Eberly Mills indulged in telephonic talk whenever they felt like it, long before Bell had even begun to dream about the possibility of the thing. It is said that although Drawbaugh failed to establish his case, he now has new evidence, and that, aware of this fact, the American Bell Telephone Company are tampering with his witnesses. So persistent is all this effort we begin to believe it is being used to boom Drawbaugh stock again. It can have little other effect, for, unless we are mistaken, no new decision in the matter can well be reached until the fundamental Bell patents have run their natural term.

Electricity on the Sea. THE International Marine Conference that will begin its labors at Washington on the 16th instant will have a number of important topics before it, and with some of them electricity is closely concerned. In fact, the very first subject on the list, as arranged by the American delegates, is "marine signals" by day and night, as a means of preventing collision, and in this department alone electricity already plays no mean part, while the growing use of the electric search light promises that at no very distant date every vessel above a certain speed will be required to carry such a light. Another subject is that of night signals for communicating information at sea, while special attention is also to be paid to buoys and beacons, storm warnings, etc. A topic of great interest, too, is that of saving life and property from shipwreck, and no doubt Mr. Kimball will tell what he has done in enlisting the telephone into the service of the Life Saving Corps. All the great maritime nations will have delegates in attendance, and much may be expected from the deliberations of the body.

Notes from Paris. IN this issue we publish an extremely interesting batch of notes from Mr. Wetzler on Paris and what the Exposition has to show. We also bring to a close the series by Mr. W. J. Hammer, on the Edison exhibits, a collection that well deserved the praise and thanks accorded by M. Spuller, when, in giving Mr. Edison the Cross of Commander of the Legion of Honor, he said: "*Nous sommes heureux de vous l'offrir en souvenir de votre voyage à Paris, et de votre participation à l'exposition universelle à laquelle la grande Republique des Etats Unis a pris une part si brilliante, affirmant ainsi une fois de plus les liens indissolubles qui l'attachent à la France.*" It is pleasing to know that American participation is so highly valued, and that it has been one of the elements in the success of the Exposition. But it should not be forgotten that American electrical exhibitors were greatly indebted in their turn to the assistance given them in their work by M. Abdank Abakanowicz, a gentleman who, from the first, was anxious to have America well and fairly represented, and who certainly deserves a tangible recognition of his efforts.

A Phonographic Era. MR. EDWARD BELLAMY, whose "Looking Backward," is one of the books of the year, has contributed to the current *Harper's Magazine* a curious and interesting article entitled "With the Eyes Shut." It is descriptive of an age—our own age a few years later—when a great many of the ideas that have been suggested by the phonograph have worked out into practice and everyday use. The conditions depicted are those of a period not perhaps unlike that supposed by the poet Cowper in the controversy betwixt eyes and nose, it being decided that when nose put spectacles on, eyes must be shut. In this case, the ear being attached to its phonograph, eyes may be shut, and the days when they are tortured by small type, dim light and weariness are gone forever. People read by phonographs, whether books, newspapers or letters, they tell the time, hear the best plays, learn the names of passing stations, "sit under" leading divines, and jog their memories, all by the aid of the indispensable phonograph, whose widespread employment has revolutionized many of the old industries and created scores of new ones. Wild as it may seem, there is, as we know, foundation for much of this, and in some respects it is not half so wild as Mr. Bellamy's nationalistic vision, wherein the new earth is itself the new heaven. Readers of Victor Hugo will remember that paper and type were to overthrow Notre Dame and all that it stood for, and rule supreme; but now the phonogram is to be mightier than the printed page.

THE DECISION AGAINST THE SAWYER-MAN "FIBROUS CARBON" CLAIM.

A decision against the Consolidated Electric Light Company in the suit with McKeesport Edison Company, on the "fiibrous fllament" claim has been rendered at Pittsburgh in the United States Circuit Court by Judge Bradley. At the present time the full decision has not reached New York, and we therefore abstain from extended comment. Enough has reached us, however, to show that the broad claim of Sawyer and Man to a fibrous filament has been denied, and that the patent which, if sustained, would have given a monopoly of fibrous filament lamps, is invalid. Judge Bradley says:

"We are not satisfied that Sawyer and Man ever made and reduced to practical operation any such invention as is set forth in the patent in suit. The evidence as to what they did up to 1879 is so contradictory and suspicious we can with difficulty agree to the conclusion sought to be drawn from it. We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material, or any material, which was a success. During 1878 and 1879 they obtained nineteen electric lamp patents, and not one of them contains a hint of such an invention as that contained in the patent in suit, which was not applied for until 1880. The application for the patent in suit was not made until a year after their experiments ceased, and after the inventions of Edison had been published to the world.

"Suppose they did construct a lamp with burners of fibrous material which continued to give light for days, or weeks or months—were they a successful invention? Would any one purchase them now? Did they not lack an essential ingredient, and did they go any further in principle, if they did in degree, than lamps constructed before? It seems to us that they were following a wrong principle. The great discovery in the art was that of adopting high resistance in the conductor, with a small illuminating surface and a corresponding diminution in the strength of the current. This was done by Edison with filamental conductors in a vacuum within a globe made of one piece of glass. This discovery made electric lighting practical in houses and cities. This discovery is traced in growth in both the Edison patents.

"What was the object of all the experiments made by Sawyer and Man and others? Was it not to make an electric lamp that could be successfully used by the public and have a commercial value? Did they succeed in making such a lamp, or in finding out the principle on which it could be made? We do not so read the evidence. The bill must be dismissed."

NEW BOOKS.

Alternate Current Machinery. By Gisbert Kapp. *Science Series.* D. Van Nostrand Company, New York, 1889. Illustrated; 199 pages. Price, 50 cents.

This is a careful reprint of Mr. Kapp's admirable paper from the "Proceedings of the Institution of Civil Engineers of London," and includes also an excellent summary of the discussion as participated in by Messrs. W. H. Preece, J. Swinburne, Hon. C. Parsons, Profs. G. Forbes, Elihu Thomson, W. E. Ayrton and others. The topics treated of are, more specifically, alternators, transformers and motors, but the subject is well presented in its general relation to electrical generation and distribution. The book will find many readers, and will be of great use to all studying the theory and practice of alternate current working.

Thermo-Electricity. By Arthur Rust. E. & F. N. Spon, London and New York. 1889. Cloth. Illustrated. 32 pages. Price 75 cents.

Our readers will remember the recent publication in these columns of an interesting series of articles by Mr. A. Rust on thermo-electricity, descriptive of experiments that he had made, and unfolding some novel theories on the subject. The pamphlet is of interest, whether for its radical views or for the account furnished of the huge thermopile constructed by Mr. Rust of some 6,000 elements. If we are not mistaken, this is the first contribution in book form to the literature of an obscure but extremely important branch of investigation, from which electricity in practice will, sooner or later, be making a new departure.

The Evolution of the Incandescent Lamp. By Franklin Leonard Pope. Elizabeth, N. J. Henry Cook. 1889. 91 pages. Illustrated. 8vo. Price $1.

This is a very interesting work, if only because of its important subject matter. The tiny little exhausted glass bulb, with its glowing filament, has proved to be one of the best and most beautiful of the gifts of modern science and invention, and even the unscientific man is glad to know something of its history. The theory that Mr Pope advances is, we believe, in the main the true one that such great new arts are in the nature of an evolution, and are necessarily the product of many brains, rather than of one. It will be remembered that Mr. Pope has himself lately applied this theory to the case of Morse and Vail, endeavoring to secure for the latter a part of the credit of the development of the Morse telegraph. As Mr. Pope well puts it: "Even in those rare cases in which an improvement of indisputable novelty and originality is made known to the industrial world, it is scarcely ever sufficiently perfected in its details to be capable of practical use until it has been worked upon and improved by many hands and many minds."

But still, after all, great ideas and advances, whether in the moral world, the social or the scientific, find their embodiment, crystallization or most clear cut form in some personality, and hence the work of the individual must be honored and admired and rewarded. Mr. Pope has himself admitted this in his advocacy of the claims of Professor Bell to the invention of the telephone, and he now does so again in his exposition of the work of Sawyer and Man in perfecting the incandescent light. The book is written for the purpose of doing those two men justice, and in that respect is a masterpiece of skillful compilation and rhetoric. It is impossible after this that, by the public at least, however the courts may regard the matter; their special claims will be forgotten; and so far has Mr. Pope achieved his purpose. But the final history of the incandescent lamp, when it is written by-and-by, will be an even better illustration than Mr. Pope's book of his own excellent theory of the evolution of the arts. In other words, it will not overlook or neglect the work done in Europe as well as in America by other inventors. We find, for example, not the slightest reference to the work of Mr. Swan; and other European workers, except Lane-Fox, also suffer from Mr. Pope's "sins of omission." As for work done on this side, Mr. Pope's narrative deals naturally and of necessity with Mr. Edison's investigations and inventions; but it is an open secret, we take it, that Mr. Edison would hardly select Mr. Pope to state his case for him. Aside from its value in presenting a skillful and brilliant resumé of the Sawyer-Man claims, the book is interesting also on account of its reproductions of early patents, newspaper articles, etc. It is not a complete history of the art, but the day has hardly yet arrived when a complete, clear and candid history of it can be written.

Transactions of the American Institute of Electrical Engineers. August and September, 1889. Published by the Institute, New York. 122 pages.

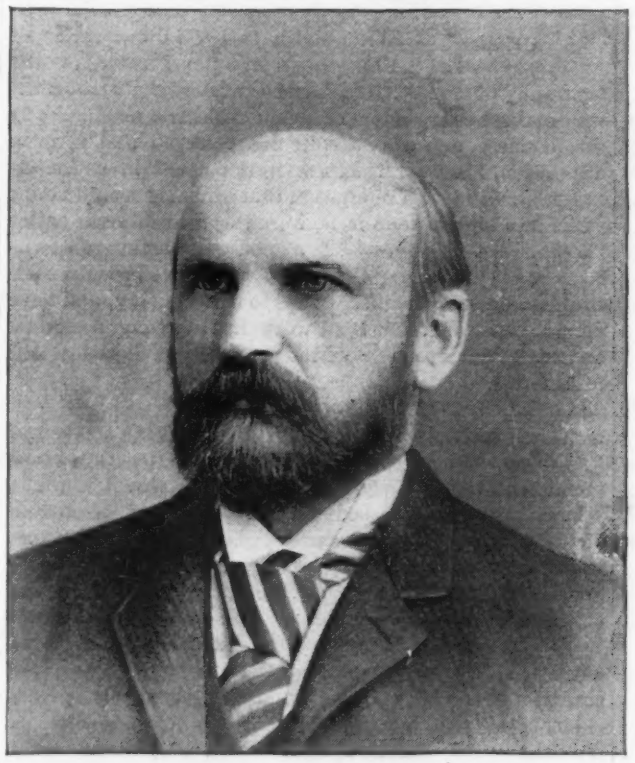
This is a very valuable and interesting Part of the *Transactions* of the Institute, reflecting not a little credit upon that body and its secretary, Mr. R. W. Pope. It embodies a number of the papers read at the annual meeting, including "Magnetism in its Relation to Induced Electromotive Force and Current," by Prof. Elihu Thomson; "On the Relation between the Initial and the Average Efficiency of Incandescent Lamps," by W. H. Peirce; "The Efficiency of the Arc Lamp," by H. Nakano; "The Spiral Coil Voltameter," by H. J. Ryan, and "The Personal Error in Photometry," by Prof. E. L. Nichols. It gives also Prof. H. A. Rowland's thoughtful and suggestive address "On Modern Views with Respect to Electric Currents." Bevond this it contains also an Index of Current Electrical Literature for March, 1889, and a complete classified and dated list of honorary members, members, and associate members, showing a total of no fewer than 350 in good standing. Such a publication as this is in itself a proof of the industry and patience with which the Institute is pursuing its career and endeavoring to build up the electrical engineering profession in America.

ELECTRICAL WORLD PORTRAITS.—IX.

WILLIAM HOCHHAUSEN.

Mr. William Hochhausen, whose face we have the pleasure of presenting on this page in our series of Electrical World Portraits, is a German by birth, and thus belongs to one of the strongest and best elements that go to the making of the new American nation. He was born in Jena, Germany, so celebrated for the great battle fought there by Napoleon; and was educated at the well-known University of Jena, with which are associated the famous names of Fichte, Schelling, Hegel, Voss, Schlegel and others. Here the young Hochhausen showed a strong bent for physics and mechanics, and spent some time under the tuition of the University mechanician. At the age of 18 he went to Berlin and entered the employ of Siemens & Halske, a firm still in prosperous existence, and one in whose service many able electricians have learned the electrical arts. In course of time Mr. Hochhausen joined the Vienna branch of the house and also worked for other firms, chiefly in the manufacture of instruments of precision and all kinds of electrical apparatus.

At the age of 23, however, Mr. Hochhausen felt himself cramped in his opportunities, and like many another Teuton longed to see something of the world beyond the borders of the Fatherland, or even of Europe. He set out accordingly on a trip around the globe, leaving Hamburg for Australia. Arrived in the Antipodes, he devoted himself for two and a half years to engineering. Then he made a remove to the Sandwich Islands, and from that remote place he sailed to California, where he spent some eight months. But California in those days offered little inducement to an electrician, and so at last, in 1867, he made his way to New York, via the Central American route.



WILLIAM HOCHHAUSEN.

Arrived in New York, Mr. Hochhausen was not long in forming a connection with the old and noted house of Charles T. & J. A. Chester, pioneers in the installation of fire alarm systems in this city, and makers also of telegraph instruments. In 1871, Mr. Hochhausen went into business on his own account, making a specialty of telegraph apparatus and experimental work, doing a large amount of construction for the Gold and Stock Telegraph Company. When the American District Telegraph system came into vogue he built all the necessary plant for it. Early in 1874, Mr. Hochhausen, who had followed closely the evolution of magneto and dynamo electric machines, built his first dynamo to the order of Mr. Alfred Holcomb, and from this point of departure plunged deeply into the mysteries and difficulties of dynamo construction as then practiced. It was not long before Mr. Hochhausen found himself busy building dynamos for plating and deposition, and then for arc lighting. This was an interesting period of his career, and was marked by various changes in his commercial relationships, until in 1881, the merits of his work in the new field of electric lighting being recognized by capitalists, the Excelsior Electric Company was organized to manufacture under his patents and to place his apparatus for lighting, plating, etc., upon the market. Since that time the system, which was illustrated in our columns as far back as the beginning of 1884, has been steadily improved, and its merit is shown by the fact that it ranks among the leading survivors of a period of intense and perhaps unparalleled industrial and technical competition. Mr. Hochhausen has, moreover, developed an incandescent lighting system, a variety of ingenious apparatus for regulation and measurement, and a series of excellent motors for the constant current and constant potential circuits. He is still constantly engaged in experiment and invention, and may be confidently depended upon to add frequently to the long list of useful appliances that bear his name and are of use in the practical applications of electricity.

"Crank" Uses for Electricity.

BY FOREE BAIN.

The following is a letter which I received recently through the mail. It is, no doubt, one of the results of advertising with a paper having a large and general circulation everywhere:

"gentes I notised your idvertisment in the electrcal World. gentes can you make a instrement that will find money 3 feat oundear ground. i want a instear meant that i can find gold or silver three feat undear ground. i will pay cash for one or i will pay ten per cent ann one hundred thousand dollars in Silver and gold whitch is beairred and cannot bee found. a gread eal of money is beaired in this countty and the parties Would bee glad to find it ond a gread meney have ben in luck while othears have not ben in luck. please let me no whot you can doo by return mail i mean whot i say if you can doo me iney goo you ar the man for me and if you can not let me no please address in full name to ——"

I am frequently called upon to invent and devise all kinds of machines, with which the mysterious power of electricity is to "revolutionize" something or other.

Quite a number of the ideas and suggestions offered by my clients are novel, and a number of the machines which are made to carry out their "ideas" prove to be very practical and valuable.

In a great many cases a "vague idea" is the only basis they give upon which to devise and construct a machine or apparatus that will, when completed, contain a dozen or more important inventions.

It is remarkable how all the branches of industry are looking to electricity as a means to more cheaply or rapidly perform the various operations incidental to manufactures of all kinds.

A more general education in the art of electricity will no doubt increase its use in the various shops and factories throughout the world. There are now a number of articles manufactured which could be greatly cheapened and the process quickened by using electrically operated mechanism.

If space permitted, or my time, I could give you a long list of curious machinery to which I have applied electricity for the purpose of more accurately and rapidly manufacturing various things that would, perhaps, prove interesting reading. There is also the ludicrous side, as the foregoing letter indicates, but this is only one of many. I once built a "pump" for a very intelligent gentleman (bright in regard to other subjects), with which he was to "pump electricity from the earth" (design furnished in such cases as these); another "machine" that would "vitalize" goose eggs to improve the strain of geese; and a third apparatus built from drawings furnished, which was "designed" to locate oil wells. A man came to me one day and ordered a very large solenoid to be made. He assured me that he could put a person within the solenoid, and when a current of electricity was circulating within the wire, of which the coil was made, the person would lose the control of his own will or mind, and that he could by means of his will power take control of theirs. I furnished the coil, but did not witness any experiments.

Cade's Railway Telegraph.

A new form of railway telegraph has been invented by Mr. Baylus Cade, of Louisberg, N. C. This apparatus is of the contact type, and consists simply of an ordinary box sounding relay with a key on the base, which is placed in the circuit, and maintained there no matter how fast the train runs. The difficulty of constructing a circuit which would allow instruments on the trains to be thrown into circuit and kept there while trains were in motion is, it is claimed, entirely overcome, and the cost of construction will not exceed $50 per mile, the instruments being capable of adjustment to the car in five minutes. It also has the great advantage that the operators require no "phones" to detect the sounds, and can always know if there is any trouble on the line; whereas in the inductive method, if the current in the line conductor fails for any reason to act inductively, the train operator has no means of knowing of such failure.

Glimpses of the St. John, N. B., Electrical Exhibition.

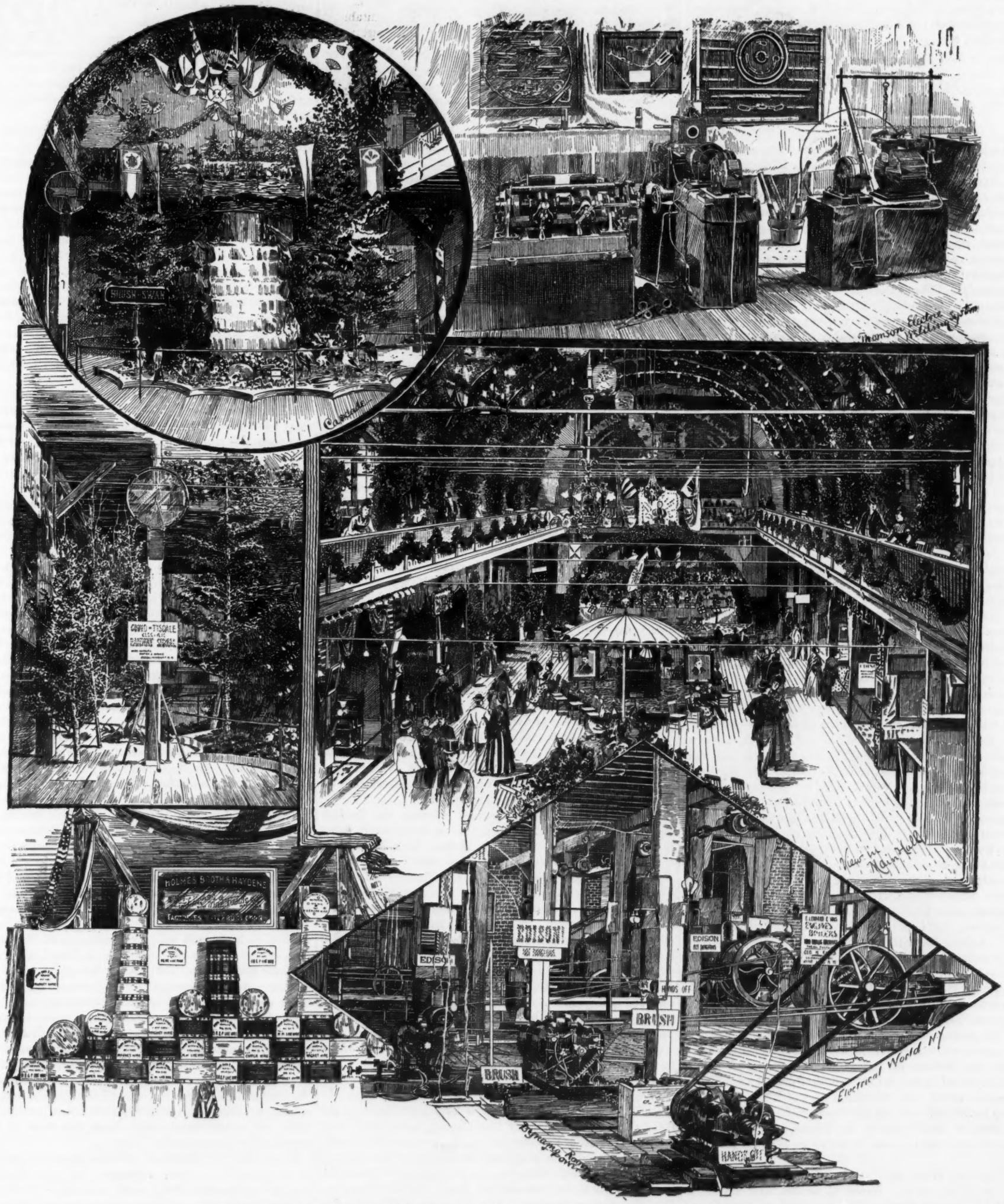
As our readers will remember, a very successful electrical exhibition has recently been held in St. John, New Brunswick, to celebrate the corporate union of that city with the sister city of Portland, and also to signalize the completion of the Canadian Pacific Railway from Montreal through to St. John and the Atlantic seaboard.

This exhibition was the first of the kind ever held in a British colony, and was remarkably successful, thanks mainly to the ability and energy of its electrical superintendent, Mr. A. A. Knudson, and his assistant, Mr. Cogswell. It has already been productive of great good, for St. John not only proposes now to adopt incandescent lighting on a large scale, but Mr. Knudson is investigating electric railways with the purpose of placing an equipment on the roads in the cities of St. John and Halifax. Other developements of an encouraging nature can be traced directly to the exhibition.

The large illustration on this page shows some of the most prominent features, and for a detailed description we may refer our readers to the special correspondence from St. John, appearing in these pages on August 3. At the top of the cut appears the Thomson welding exhibit and the cascade lit by Brush-Swan lamps. Immediately below is the main floor, lit by Edison lamps from Bergmann fixtures, etc., and showing the electric organ stand, the music stand, galleries, etc. On the left is a view of the Gould-Tisdale electric railway signal. Beneath these are seen the Edison and Brush dynamo exhibits on the first floor, with the fine display of wires by Holmes, Booth & Hayden.

Altogether, St. John is to be congratulated upon its enterprise and taste as shown in this exhibition, which has done not a little to call attention to the large resources and opportunities of an important part of the British Empire, and of a section whose nearness to our own manufacturers promises an excellent market.

It is encouraging to note that, as our illustration exemplifies, American companies and firms are already devoting their energies to the occupation of this new and comparatively unworked territory, which may be reached the same day from Boston, and is within thirty hours of New York.



GLIMPSES OF THE RECENT ELECTRICAL EXHIBITION AT ST. JOHN, N. B.

Observations on Gerricide.

BY DR. HAMMETT HILL, M. R. C. S., ENG.

The employment of electricity (voltaic or other modification) in carrying out the death penalty in lieu of hanging is at the present moment exciting much interest in the scientific and humanitarian world. The most opposite opinions are promulgated by scientists as to its use, some even going so far as to say that it is almost impossible to cut short the thread of life, at all events with any certainty, by the employment of this imponderable agent—and this, forsooth, in spite of the many fatal accidents to man and beast already recorded!

About sixty years ago I was a student of medicine in London, England, and being of a mechanical and ingenious turn of mind and taking much interest in frictional electrical experiments, I constructed a tubular machine about 10 inches long by 7 or 8 inches diameter, with which I could perform the usual experiments exhibited in lectures on natural philosophy. A Leyden jar was, of course, requisite; it was about 6 inches high and about 3 inches

in diameter, and exposed a surface of tin foil in the inside of about 45 square inches. With this simple little apparatus I could kill mice "as dead as a herring" without one solitary struggle or other indication of pain. Lightning, it is well known, does the same continually; its identity with frictional electricity was fully understood by the illustrious Benjamin Franklin, whose experiments were immortalized in the couplet: "*Eripuit fulmen e cœlo sceptrumque tyrannis.*" A battery of Leyden jars charged with frictional electricity would accomplish death with unerring certainty in the human race, though I hesitate to say how many or how few. That fact must be determined by experiment on the larger animals, such as the horse, the ox, the cow, etc.

Notes of the Paris Exposition.

[*From Our Own Correspondent*]

Paris, Sept. 9, 1889.

The telephone exhibits at the exhibition are quite numerous, as besides the large exhibit of the Bell Telephone Company, mentioned in a former letter, quite a large number of French exhibits are to be seen. Such a collection of various manufactures strikes the American as somewhat curious, considering that we have but a single company furnishing telephones. This is due to the fact that in France the manufacture of telephones is practically open to any one, and the result is that private line instruments can be bought very cheaply. Thus at the exhibition I saw a set of two instruments which could be bought for seven dollars, including transmitter and receiver. The articulation, which I took occasion to try, was tolerably good, a modified form of the Ader transmitter being used, this being the principal form employed in France. The Van Rysselberghe system of simultaneous telegraphy and telephony is also exhibited.

In the department of telegraphy there are shown various methods of transmissions, including the Hughes and the Baudot system.

Probably the most novel thing in this line is the stenotelegraph system of Cassagne. This is shown in the gallery of the Machinery Hall, and is certainly a very ingenious method of transmission. It is, in fact, a method of phonetic transmission by which certain combinations of signs stand for certain sounds, which therefore permits of considerable speed of transmission. The operator has placed before him two small key-boards containing ten keys each, and the different combinations effected when these are depressed enable practically all phonetic sounds to be transmitted to the other end of the line. The system employs the La Cour phonic wheel, by which all the keys depressed at any one time have their signs transmitted during one revolution of the wheel. In actual practice it is claimed that 260 words can be transmitted per minute by a skillful operator. I took occasion to dictate a paragraph from a newspaper at a fair rate of speed, and the operator was able to follow me with ease; and what is more, to decipher the characters at the other end of the line. Of course, the system is only shown on a short circuit, so that the influence of retardation on the line was not included. For any distance, however, to which the synchronous system can be employed, it would seem to be a feasible plan. M. Cassagne is now working at a further development of this system, which I also saw in partial operation, in which the words are transmitted phonetically in Roman characters, so that any one, with very little practice, can read the message at the other end of the line.

The exhibit of carbons and the manufacture of carbon generally, which is exclusively French, is a very creditable one indeed, some beautiful examples of this class of work being shown by Carré, Goodwin, Levy, Lacombe and others. Among other things shown in this line are carbon tubes of very small bore, and carbon "squirted" filaments as fine as hair.

The primary battery exhibits also figure here to considerable extent, as the French are particularly devoted to installing small experimental plants of this nature. Thus we have the Radiguet battery, in which when the battery is not in operation the active liquid is transferred from the zinc by the turning of the vessel containing it, which allows the liquid to run out into another pocket attached to the porous vessel and forming a part of it, but glazed so that the liquid does not run out through the pores. In another form of battery shown by Legarde the carbons are constantly revolved by clock work so as to avoid polarization.

MM. Richard Frères shows a variety of electrical instruments, including various forms of meters and registers, some of which have already been described in The Electrical World. The Cauderay meters are also shown in various forms. Though very ingenious in construction, they seem to be somewhat complicated and hardly adapted to practical work as an every-day instrument which could be placed in a cellar and remain for months without inspection.

A rather curious exhibit is an electric clock made by M. A. Rever. In this clock the pendulum is kept in movement by the attraction of an electro-magnet on an armature placed on the end of the pendulum. Attached to the pendulum is a small auxiliary arm which swings freely, independent of the movement of the pendulum itself. It is so arranged that in a certain position it makes a contact which closes the circuit and energizes the magnet which attracts the armature on the pendulum. But this contact is only made when the pendulum has a tendency to reduce its amplitude of vibration. It follows, therefore, that when the pendulum has the tendency to cease in its movement an impulse is given which attracts the armature and keeps up the motion. It is so arranged that at about every six vibrations of the pendulum the impulse is given. It is probably more a curiosity than an instrument of precision.

The display of electro-plating work is a very creditable one. The celebrated French manufacturer, Christofle, shows a large variety of work, from the ordinary plated table ware to ornamental work and statuary. The beautiful shades and colors brought out with the different metals employed, and even with the same metal, are remarkable exhibits of the variety and richness of which this process is capable; and it is difficult to distinguish some of the work shown, consisting of plaster casts plated, from the genuine bronze and alloy work. Some very fine examples of cobalt plating are also shown in this section.

Messrs. Alioth & Co., of Bâle, exhibit quite a number of their "Helvetia" dynamos, which have been illustrated by the papers here.* The machines are of the multipolar type with four radial poles fixed to an external ring forming the magnetic yoke. The armature is of the drum pattern with saddled-shaped coils, which are wound on special formers and slipped on to the core embracing arcs of about one-quarter of the circumference, and so arranged that single coils can be removed without disturbing the others, thus enabling repairs to be made with great facility if any trouble occurs. Two sets of brushes are employed set at 90 degrees apart, the holders being attached to a gun-metal ring which can be shifted by means of a hand-wheel rack and pinion.

Though not included in the electrical section, there is a very interesting application of electricity in the textile department. In this instance electricity is employed for the purpose of obviating the necessity of the cumbrous Jacquard perforated cards employed on looms weaving figured patterns. The system employed is quite similar in some respects to the Leggo system of telegraphy employed for some time in the Postal Telegraph Company's service. In this system it will be remembered the Morse characters were first printed, as it were, on copper cylinders with an insulating ink. These cylinders were then placed in circuit with the main wire, and rapidly revolved, a stylus in contact with the cylinder making and breaking the circuit in conformity with the insulating substance which represented the Morse characters. The system employed in this instance is quite similar. The pattern to be woven is also drawn in insulating ink on a cylinder over which there passes a contact. The threads are held in position by thin rods controlled by electro-magnets; thus as the contact passes over the figured cylinder it "throws" only those threads which come into the circuit, as controlled by the figure drawn in insulated ink; and in this way the pattern is woven as an exact reproduction. The process, of course, is a continuous one, and the machine occupies far less space than would be necessary with a Jacquard loom.

In the United States industrial section there is a very extensive display of the Gardner electric time service as in use at the Naval Observatory at Washington. There is also a clock shown here connected with the Paris observatory by this system, and showing the standard time.

The Heisler exhibit is on the line between the English and American exhibits. Though the space allotted to them is very limited, being only 13 by 16 feet, they have made the best of it, and indeed show what can be done in the way of compressing electric light installations into small space. Within their space it is said there is all the apparatus necessary for furnishing street and private lights for a medium sized town. The exhibit contains a Heisler machine for series incandescent lighting, together with the regulator already described and illustrated in your columns, which permits of the machine being run at any desired capacity, from one light up to the full load. The system has received quite some attention here, and various articles have appeared upon it in the technical papers. The United Gas Improvement Company, of Philadelphia, which has acquired the Heisler system, is making active preparations to introduce it in Europe, and has put Mr. A. Graner, the former secretary of the Heisler Electric Light Company, in charge of the Paris exhibit and the European affairs in general. I understand also that a large installation of the Heisler system has already been begun in England in a town not far from London, in which considerable trouble was experienced with a system which had been placed there before. I also learn that prospects are good, and that similar plants will be erected in France and Germany before the winter sets in. The machine exhibited in the space has the capacity of a good many lights, and besides furnishing light to their own space they also light up that of William Sellers & Co., of Philadelphia, the well known manufacturers of machine tools. Mr. Graner has as his assistant at the exhibition Mr. Etremps, who is one of the pupils of M. Hospitalier, and a graduate of the Ecole Municipale de Physique et Chimie Industrielle of Paris.

In the installation of storage batteries in connection with private lighting difficulty is experienced due to the fact that during charging the batteries require an increased potential over that given out during discharge. The result is that the lamps on the circuit are subject to the influence due to change of potential, and unless measures are taken to prevent it, are run at a dangerously high incandescence during the charging of the battery, due to the increased potential on the circuit. Usually this is avoided by changing the combination of the cells so as to maintain the potential constant all the time, or by adding or subtracting cells from the circuit. To accomplish the same object of maintaining the same potential at all times, M. P. Dujardin exhibits a very simple potential regulator, which operates by throwing in a resistance into the main circuit. This is accomplished by means of a relay which acts on an armature, and which, when the potential is at its normal point, leaves the armature free. Any increase or decrease of potential from this point causes a movement of the armature which closes one of two contacts, sending a current through a vibrator arrangement which acts to cut in, or out, resistance in the main circuit until the standard potential is again established. Of course, some waste must occur here, but the apparatus is remarkably simple.

The Thomson-Houston exhibit in Machinery Hall covers a space of about 25 by 45 feet, and contains an example of nearly all the electric lighting work of the Thomson-Houston Company, while on the other aisle it faces the exhibit of the Thomson Electric Welding Company. The exhibit of the former contains the smallest type of incandescent machine made by them and run by the smallest type of motor. Just back of this is the largest type of generator, having a capacity of 62,500 watts and wound for 500 volts potential, as ordinarily employed for railroad work. This machine runs the electric railroad truck in the railway department and the 40 h. p. Thomson motor in the Agricultural Department. Run from the same counter-shaft on the other side of the passage are two alternating machines, one for the compensator system of distribution at 300 volts, and the other for the transformer system at 1,000 volts, and for the street system of forty 25-volt lamps in series. One of these alternators is self-exciting while the other is compound. In the latter, part of the field magnets are separately excited while the others are excited by the main current, which is rectified by a commutator, and, after passing through the fields, is again rendered alternating before passing out into the main circuit. Close beside this is a 50-light arc machine running arc and incandescent lamps in series. One corner of the space is occupied as a storehouse, on the three outer walls of which are mounted the switch boards of the various systems in operation. You have already illustrated the exhibit.

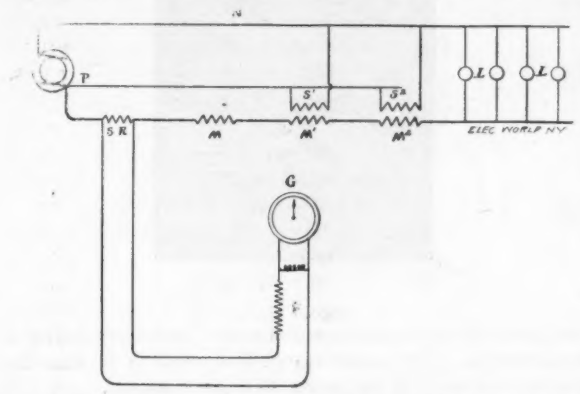
The exhibition at night may, with the exception of Machinery Hall, be called an exhibition of light, as, besides the hall mentioned, all other buildings on the ground are closed, there being no provision made for lighting them. The Machinery Hall is lit by clusters of arc lamps suspended from the roof, the incandescents being largely confined to the illumination of the walks and for the ornamental effects about the grounds. The light is furnished by a syndicate consisting of the various electric lighting firms, who receive half the evening receipts taken in at the gates. Notwithstanding the limited part of the exhibition itself open, the attendance at night is very large, and the grounds are indeed well worth a visit to witness the light effects shown. To begin with, the Eiffel Tower has a plant of its own, installed by Messrs. Sautter, Lemonnier & Co. The generating plant is placed in the southern pier of the tower, and consists of a machine which furnishes current for the powerful light placed in the lighthouse in the top of the tower, for two projectors, and for several hundred incandescent lamps placed about the tower. The lighthouse at the top of the tower is of 55,000 c. p., and in clear weather, it is said, can be seen for a distance of over a hundred miles, the lenses amplifying its power ten times. The lamp itself, though a focusing automatic, can be worked by hand, and takes 100 ampères of current at 70 volts. The carbons are about an inch and a quarter in diameter and last for six hours. The light is of the revolving type, the revolution being effected by means of a small electric motor which takes current from the regular lamp circuit. As also remarked, there are two projectors placed on the topmost platform of the tower. These are used to light up various objects about the Exhibition, and when turned upon the various works of statuary, notably the collossal figure on top of the central dome at the entrance of Machinery Hall, produce the most beautiful effects. The lighting arrangements of the Eiffel Tower are very complete, and reflect great credit upon the work of Messrs. Sautter, Lemonnier & Co.

The visitor from the States who has occasion to go abroad at night in Paris, upon emerging from the Exhibition, which is brilliantly lighted in all parts, both by electricity and gas, enters into comparative darkness, and sighs for the arc lamp which he is accustomed to see at the street corner of even the smallest towns of the States. With the exception of the lights on a few of the boulevards there is no electric street lighting in Paris. When the Exhibition was about to be opened the Paris municipality, considering it important to have its streets, at least in part, well lit, gave out contracts to different companies, allotting to each about fifty lamps. Among these companies were those operating the system of Marcel Deprez, the Edison Company and Thomson-Houston Company. These lamps are placed on the Rue Royale, running from the Place de la Concorde up to the Boulevard de la Madeleine along the Boulevards des Capucines, des Italiens and Montmartre. I took occasion to examine the Thomson-Houston system, which is run in

* We are indebted to *Industries* for the illustration on page 247.—Eds. E. W.

connection with the Popp system of distribution of power by means of compressed air. One of their installations is placed in the Edén Theatre, where they have two machines furnishing 60 arc lights. Of these 49 lights are employed about the theatre, eight of which are employed as foot lights, and from this station also 11 street lights are run. At the other station on the Boulevard des Capucines two machines operate 29 public lights and about 14 or 15 private lights. All the circuits, of course, are under ground, and the lamps are in series. On the other arc system the lamps are connected two in series across the lines, the E. M. F. being only 110 volts.

Such as it is, the arc lighting in Paris is good, the Rue Royale, less than one-quarter of a mile long, especially



THE METER COMPETITION TESTING ARRANGEMENT, PARIS.

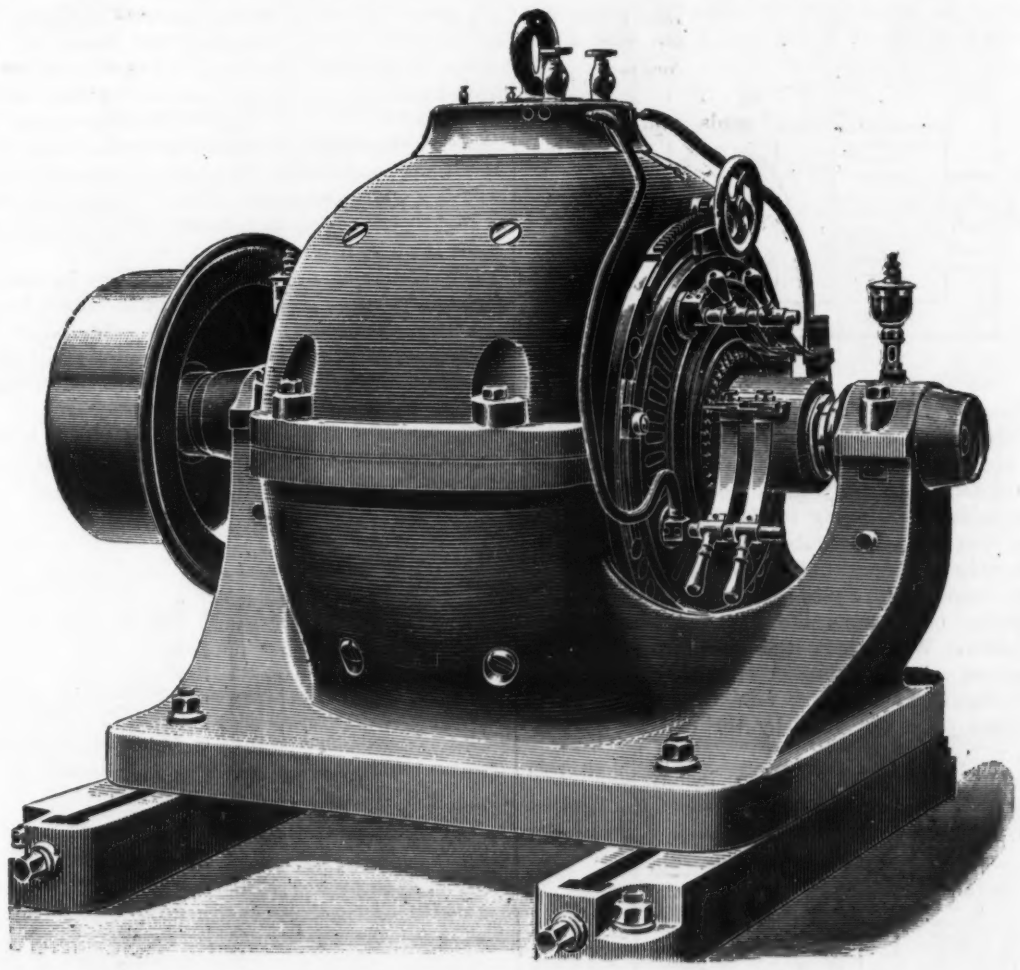
being very well lit. In looking over the ground, however, it would seem almost certain that considerable economy could be attained by the use of arc lights in Paris to replace the large number of gas lamps in use. To be fair, it must be said that the Paris authorities are by no means stingy in their use of gas on the streets, but the results obtained are, it seems, not up to the cost which such a large number of lights must involve. Take for instance the Place de la Concorde, a space measuring about 500 to 700 feet and containing probably between 500 and 600 gas lamps. There can not be the slightest doubt that 30 or 40 arc lamps well distributed would give a far better illumination than is now obtained. Again, on the Avenue des Champs Elysees, there are running from the Place de la Concorde up to the Arc de Triomphe, a distance of about a mile and a half, four rows of gas lamps, the latter being placed at an average distance of fifty feet apart, while at frequent intervals in the middle of the roadway two extra high gas lamps are situated. Thus, while I would not advocate arc lamps in some of the narrow, crooked streets of Paris, there are a sufficient number of beautiful, wide streets in which the arc light would show up to the improvement of the street and conduce to economy at the same time. As I have said before, the present arc lighting in Paris is merely provisional, but it is greatly to be hoped that at the end of the Exhibition some permanent arrangement will be arrived at and the system extended.

As your readers may be already aware, the city of Paris some time ago commenced the construction of a central electric light station, and in anticipation of furnishing current to customers, was desirous of obtaining a good electric meter. For that purpose it opened a prize competition, in which any one was allowed to enter his meter. A prize was offered for the best. These meters are now being tested at the Hotel de Ville, in the office of M.Chretien, the chief of the City Electrical Department. I saw no less than twenty-three different meters of all varieties being tested, and as the test is still going on, no definite information as to the results can, of course, be given. Among the meters there are two American meters; the Edison, which, however, is not entered in competition, but merely for the purpose of test, and the Geyer-Bristol meter, which has already been described in THE ELECTRICAL WORLD. In undertaking a test of this kind, it is, of course, absolutely necessary to have all the conditions exactly alike for each meter; for that purpose they are all connected in series, so that there can be no question of the same current passing through each instrument. The testing arrangement is shown diagrammatically in the accoming sketch. Here, it will be noted, the various meters, M, M^1 and M^2 are connected up in series. As most of the meters are watt-hour meters, in which one coil carries the main current, and a second, a high resistance shunt, measures the potential, an arrangement has been effected by which the potential furnished to the potential or shunt coil of the various instruments is the same. It is evident that if these coils were connected across the line directly, the difference of potential measured at each point would vary, on account of the drop in the line wire. To avoid this a potential wire is connected directly to the dynamo brush at the point P, and run independently to the various instruments, so that the shunt coils, as, for example, S^1 and S^2, have practically the same potential, the drop in the line N, which is a heavy wire, being negligible.

The method of test employed is the well-known fall of potential arrangement. A standard resistance, $S\,R$, is placed in the main circuit, and the difference of potential at its terminals is measured by means of a Deprez-d'Arsonval galvanometer. The standard resistance, a heavy German silver coil, is very accurately calibrated by Carpentier, and the standard cell employed is the form devised by Fleeming Jenkin, in which the densities of both the copper sulphate and the zinc sulphate are at 1.20, which gives an E. M. F. of 1.106 volt. The testing arrangements are very simple, and all measurements can be easily controlled. M. G. Roux, one of the editors of *l'Electricien*, who has charge of the tests at present, kindly showed me all the arrangements.

As stated above, the city of Paris is now erecting an installation for the furnishing of electric light. The station is now being constructed and is situated under the cellars of the Halles Centrales, one of the large markets of Paris. The large arches under these structures afford ample room for a large station, and great pains are being taken to have everything of the best order. There are now in position six Edison machines capable of furnishing 450 ampères and connected on the three-wire system. These machines will furnish current for 450 incandescent lamps, situated in the Halles Centrales, and 170 arc lamps. The latter will be connected, four in series, across the two outside wires of the system, having a potential of 220 volts. Besides this, these machines will furnish 1,500 incandescents for street and private lighting in the vicinity of the station. During my visit there had just arrived the first Ferranti machine, of which three are to be installed also in this station. These will be operated at 2,400 volts, and the two which will be in operation, one being in reserve, will be able to furnish current for 4,000 lamps and extending for a distance of two kilometres from the station. The conductors are all underground. I inspected some of the conduits in company with M. Lafargue, the electrical engineer in charge of the works. The conduits are of masonry covered with cement, and about 10 inches high and 14 inches wide. At suitable distances, supported by high wooden frames, is a central rod carrying hooks on each side, which support the wires. This central suspending arrangement is made of iron vitrified, so as to act as an insulator at the same time. The cables are gutta-percha covered and have no other protection. The specifications call for an insulation resistance of 3,000 megohms per kilometre. These conduits are run under the sidewalks as close to the house line as possible, but where streets have to be crossed they are dropped vertically for a distance in some cases of 20 feet, so as to pass under the sewers to a similar hole on the other side of the street and then up again under the sidewalks. Drainage arrangements are provided, and the construction appears to be quite a substantial one, as indeed everything in connection with this station is. The city is evidently sparing no expense to make this a model installation, and as the work is in good hands, the results obtained will no doubt be very satisfactory.

As Paris may be considered the city of underground wires, I took occasion to go down into the sewers and look into the manner of suspension of the cables there. These wonderful underground structures naturally make the underground distribution of wires very easy, and the consequence is that a large number, in fact all wires in Paris, are underground; they are suspended from the roof by iron hangers and the majority of them are rubber-covered without any protection. A number of telephone cables, however, are covered with lead. The electric lighting wires employed on the boulevards, however, are run in separate conduits, as, according to my conductor, their presence in the main sewers was objectionable on account of the danger from leaks to the employés; there are, however, one or two arc light circuits of the Jablochkoff system placed in the sewers.



THE ALIOTH DYNAMO MACHINE.

A New Thermometric Scale.*

BY PROF. G. FORBES AND W. H. PREECE, F.R.S.

The recent Electrical Congress at Paris has adopted the Joule as the unit of work and the Watt as the unit of power. The following definitions were unanimously accepted: The practical unit of work is the Joule. It is equal to 10^7 C. G. S. units of work. It is the energy expended during one second by an ampère in an ohm. The practical unit of power is the Watt. It is equal to 10^7 C. G. S. units of power. The watt is equal to a joule per second.

The *therm* as the unit of heat did not commend itself to the French members. They preferred for the present to retain the term *calorie*, notwithstanding the confusion from there being two units of that name. It is said there is only one calorie in the C. G. S. Centigrade system. But the question arose, is there any need for either the therm or the calorie? Cannot the joule be made the thermal unit also, for the latter is only a unit of work? The heat generated in T seconds by C ampères flowing through R ohms, or driven by E volts, is C R T = E C T joules. If we take the mechanical equivalent of heat as approximately 42,140,000 ergs, or 4.2 joules, it means that 4.2 joules will raise one gramme of pure water at 4 degrees C. one degree; or, in other words, that one joule expended on one gramme of pure water will raise its temperature .238 degrees C.

We have here the true scientific mode of forming a C. G. S. thermometric scale. If we take the fiducial points of freezing and boiling points of pure water at normal pressure on a column of mercury as usual, and divide the distance into 420 divisions, then each division is a true C. G. S. unit of temperature, and will be passed by the expenditure of one joule per gramme of water. Instead of employing degrees of temperature we can thus use these units of temperature, and we can replace the angular symbol x° by t or ϑ.

Thus to raise one gramme of water from freezing point to boiling point requires 420 joules, or to raise it to boiling point from 62 units it requires 358 joules. There would be no necessity for any coefficients, and calculations would be simplified.

Degrees Centigrade would be simply converted into three units by multiplying by 4.2 and degrees Fahrenheit by deducting 32 degrees and multiplying the remainder by 2.33. An objection to such a scheme has been raised by Professor Potier, of Paris, and it is that the mechanical equivalent of heat has not yet been determined with sufficient accuracy to justify its adoption as final. This ought to be a reason to re-examine the question, and with our existing knowledge of the ohm and the ampère we ought to be able to derive the joule with an exactitude that will satisfy the scientific world.

* Paper read before the British Association in Section A, Newcastle-on-Tyne, September, 1889.

Lahmeyer's System of Dynamo Regulation and Electrical Distribution.

BY LEONARD PAGET, PH. D.

Among the several methods of rendering dynamo regulation automatic that have been recently introduced it is somewhat unusual to find one embodying so entirely novel features as that designed by M. Lahmeyer, nor one having such general application. Instead of producing uniformity of work by alteration of resistance, M. Lahmeyer substitutes for the variable resistance a variable electromotive

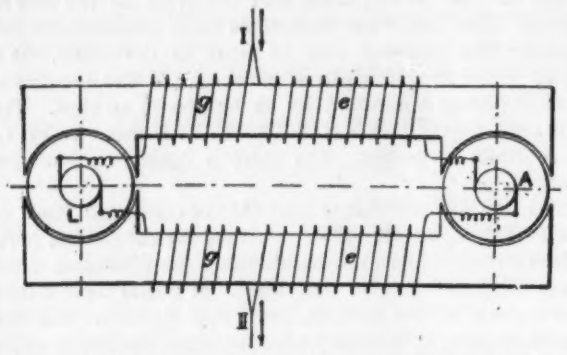


FIG. 1.—LAHMEYER REGULATION AND DISTRIBUTION.

force, foreign to the electromotive force of the generator. For example, let us consider the case of a series motor making a constant number of revolutions under variable loads, and supplied with a constant current. The product of the effort of traction exerted by the motor, multiplied by its velocity of rotation is manifested externally by its work evaluated in horse-power. The condition imposed being that the number of revolutions is constant, it is necessary that the effort of traction be made to vary proportionately to the external load. For each motor in series this effort is equal to the product of a constant by the amount of current in the armature and by the number of lines of force cut by the armature. It is then required to vary the number of useful lines of force, and, consequently, the electromotive force at the terminals of the motor in correspondence with the variations of the external load. This is at-

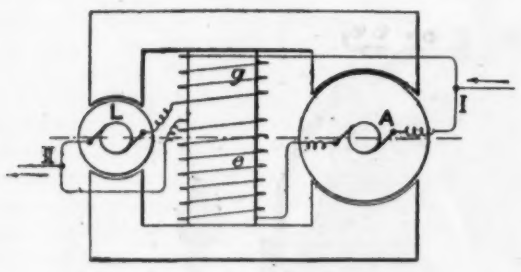


FIG. 2.

tained by varying the ampère turns employed in excitation.

We can arrive at this result by the aid of a centrifugal regulator connected to an adjustable resistance intercalated in parallel with the winding of the electro-magnets, in such a way that when the number of revolutions increases, the resistance in the shunt diminishes, and inversely.

Another arrangement would consist in dividing into a certain number of sections the series winding of the electro-magnets. We connect the leading wires to these sections so as to make a diminution of the number of revolutions correspond to a greater number of turns of the electro-magnet coils traversed by the current, and inversely.

These arrangements have a common inconvenience that limits their use. The necessary variation of the ampère-turns of excitation, from full to no load, is extremely

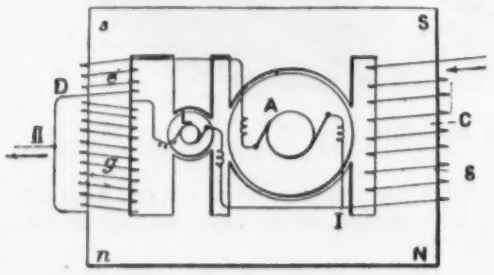


FIG. 3.

limited. This requires a multiplicity of contacts to be traversed by the lever arm of the regulator, and gives to this arm too great amplitude of oscillation from its mean position.

M. Lahmeyer resolves this difficulty by introducing the contrary electromotive force of a freely revolving armature (that is to say, having no load). The motor has two armatures, one of which does work, the other regulates.

The arrangement admits of much modification, according to the system of circuits. One consists in putting the armature in series with the winding of the electro magnets. Parallel to this circuit is a second, comprising the regulating armature put in series, with a second winding of the electro-magnets acting oppositely to the first. The second winding has therefore a differential action. M. Lahmeyer terms the first the exciting winding and the second the opposed winding.

Fig. 1 represents the arrangement diagramatically. *A* is the working armature; *e* is the exciting winding; *L* is the regulating armature; *g* is the opposed winding.

The current enters at *I* and divides between the two branches *e A e* and *q L g*, issuing at *II*. The two armatures revolving free from load, the currents will be respectively *I e* and *I g*. In this case the number of ampère-turns will be *m e I e* and *m g I g* designating by *m e* and *m g*, the number of turns of *e* and of *g*.

The windings *e* and *g* are naturally so calculated that the number of ampère-turns of the first may preponderate and the difference be positive. If, however, the armature *A* becomes loaded with work, its contrary electromotive force is lowered and the branch *e A e* will immediately take more current. Supposing that the new quantities are *I e* and *I g*, it is evident that the useful number of ampère-turns *m e I e* and *m g I g* will be greater than the preced-

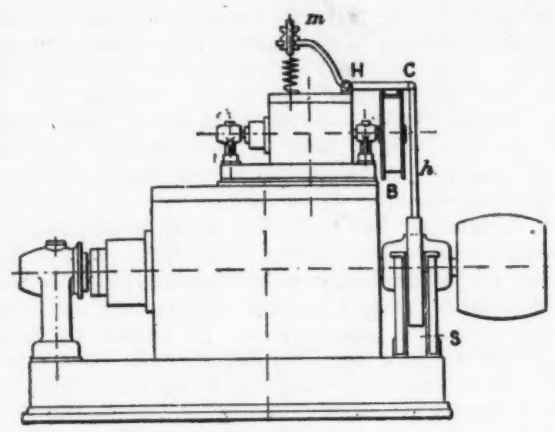


FIG. 4.

ing, because *I g* has become greater and consequently *I e* has diminished. When the load on *A* is reduced, the converse occurs.

A proper calculation of the windings of the two branches would admit of "compounding" the motor in a measure, so that the arbitrary load on *A*, by modifying the subdivision of the current *I*, produces under the differential action of the two windings the exact number of ampère, turns required for the motor to make under that load, the given number of revolutions. The regulation is aided by the fact that as a whole the displacement of current has the effect of slightly increasing the intensity in the working armature when the load increases.

The arrangement of the two armatures in series in the magnetic circuit requires that these should be of nearly identical dimensions, but, on the other hand, that the regulating armature may be very small relatively to the other, it is preferable to arrange the armatures parallel, as regards their magnetic fields (fig. 2).

The two armatures may, of course, be each in a separate motor. Neither is it necessary to produce the magnetic

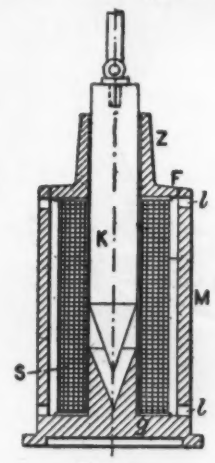


FIG. 5.

field of the regulating motor in the same manner as that of the working motor; that is, by means of two windings having differential action. The velocity of rotation of this armature being determined, it is always possible to obtain the contrary electromotive force necessary to regulation by modifying this velocity, so that its magnetic field varies with that of the working motor in the manner previously indicated, or so that the field remains invariable. The exciting current may, therefore, be obtained from a third source or by employing permanent magnets.

Fig. 3 shows another arrangement, which consists in regulating the magnetism of a dynamo by varying the ampère-turns of excitation by a magnetic derivation. *C* is the branch of the electro-magnet proper, magnetized by the winding *S* intercalated in the circuit. The branch *D* constitutes, when feebly magnetized, a magnetic derivation (shunt-keeper) that weakens the field in which the armature revolves. From the winding *S* the circuit subdivides at *I*, one part running to the working armature *A* and the exciting coils *e*, and the other part to the regulating armature *L* and the contrary winding *g*. The two windings are taken round *D*. The one *e* has a magnetizing action in the direction indicated conventionally by the letters *n s;* the other *g* a demagnetizing action. Increase of load increases the current in the first to the detriment of the current in the second. Thence results the desired increase of the intensity of the magnetic field. The conditions of regulation tending to maintain a constant number of revolutions are thus realized.

These arrangements, and others that M. Lahmeyer has developed at considerable length, restore the principle of employing an armature turning without load in the guise of a variable resistance, to regulate the number of revolutions of the working armature of an electric motor, while by consequence of the arrangement of circuits employed

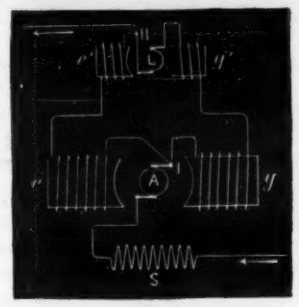
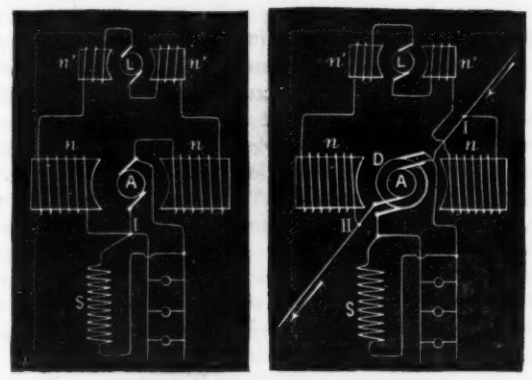


FIG. 6.

the speed of the regulation armature varies according to requirement. The condition of this method is that the current delivered to the motor remains constant.

It is possible to release this condition within limit by regulating the velocity of the small armature by means of a centrifugal regulation worked by the main armature. Let, however, there be put under consideration the application of a regulating motor, or in other words a regulating armature, to the dynamos generating the current. Suppose the current constant, and that there be employed a brake acting automatically on the regulating armature. On this brake, by means of a spring, a weight on the one hand is caused to act; on the other hand a coil traversed by the current to be maintained constant, and the action of which is antagonistic to the mechanical system. Fig. 4



FIGS. 7 AND 8.

represents a simple method. *S* is a main current coil acting on an electric piston and thereby on the levers *H* and *h*, and on the antagonistic spring adjusted by the screw *m*. *B* is a friction pulley.

For the coil in the main circuit, M. Lahmeyer prefers the following construction, shown in Fig. 5. The core *K* of the coil *S* is movable and is raised by the antagonistic effort of the spring. In the region of strongest attraction the core takes the form of a cone, in face of which is sunken a conical cavity in the base of the iron sheathing *g* of the bobbin. This base is connected to the cover *F* by the sheathing *M*, drilled with air-holes *l*. This cover is prolonged by an iron cylinder *Z* inclosing the moving core for a portion of its length, with but a small space between the two pieces of iron. The lines of force traverse iron in all parts except the short distance between the conical parts of

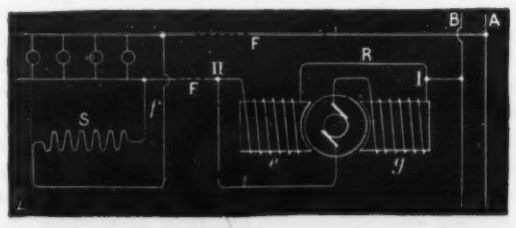


FIG. 9.

the core and base. Consequently the bobbin produces, with a comparatively small number of ampère-turns, a large number of lines of force and considerable attractive force.

Fig. 6 is an arrangement in which the regulating armature is mounted on a separate foundation. The current produced in the armature *A* subdivides at *I*, between the two windings *g g'* and *e e'*, and through the former to the regulating armature, whence from *II* both pass to the external conductor. The undivided current enters by the bobbin *S* to *A*. If this current is too strong the coil *S* draws down the brake, which allows more current to flow through *g* and *g'*, weakening the electromotive force and current output of the machine. If the current is not strong enough, the converse occurs by consequence of the raising brake.

As an instance of sensitiveness, suppose a current of 20 ampères traversing the bobbin *S*. In this case the force of attraction of the bobbin on the core is 1,900 grammes. The spring acts in a contrary direction with a force equal to 1,820 grammes. The mean pressure on the brake is 80 grammes. If the current increases to 21 ampères the attraction of the bobbin becomes 1,980 grammes, and the spring force remaining the same, the brake pressure is 160 grammes, that is, double its mean value. Consequently, since small variations in the current to be maintained constant produce immediately important variations in the brake-pressure, it follows that the regulating power is extremely sensitive, and that considerable changes in the load as well as in the speed are without effect.

The contrary windings *g* and *g'* may be omitted, and the regulation effected by variations of the current *e* and *e'* only.

If constant electromotive force is desired, choice should be made of a dynamo shunt excited, and the regulating armature inserted in the shunt instead of the ordinary adjustable resistance. The brake is then actuated by a fine wire coil *S*, put in shunt across the terminals with an antagonistic spring, so that too low tension at the terminals of the bobbin causes binding of the brake and reinforces the current in the shunt magnets.

Dynamos to be run parallel could be constructed with a single armature, carrying at the same time the motor winding with its collector and the dynamo winding with its collector respectively. This case is represented in Fig. 8 by the concentric collectors *A* and *D*. The same magnetic frame incloses the two windings, and the excitation is taken in shunt *n* across the terminals *I* and *II* of the motor. There is intercalated in this shunt, according to the arrangement shown in Fig. 7, the windings of the electro-magnets *n' n'* as well as the armature *L* of the regulating motor. Both the necessary brakes of this armature are actuated by the coil *S* put in shunt on the main conductors. For the adjustable resistance usually employed in electrical distribution at central stations to maintain constant the electromotive force at a distance on long lines, may be substituted the regulating motor.

Fig. 9 shows an arrangement in which this is carried into effect. *A* and *B* are main conductors, in which the difference of potential should be maintained constant. The motor is inserted between the points *I* and *II* in the line the terminal tension of which is to be kept constant. The branch *I R e II* includes the exciting coils *e* of the electro-magnets and a high invariable resistance *R*. The branch *I g L II* includes the armature of the regulating motor *L* and the demagnetizing windings *g* of the electro-magnets. *L* and *g* have relatively low resistances. The bobbin *S* is submitted to the action of the distant electromotive force by special conductors *f f*. It so acts on the brake system already described as that if the distant E. M. F. is lower than the normal E. M. F. the breaking of the motor increases, and inversely. The regulation by the motor is, as a rule, in these cases, related to a minimum limit of current in the line. It is possible to determine this limit. Suppose that it be one-tenth of the maximum current, the motor will then act so that a current of a value equal to one-tenth of the maximum current will determine the minimum charge or load of the brake. The greater part of the current traverses the branch *I Re II*. The motor then receives a greater number of lines of force, and *L* develops a high contrary E. M. F. As $R + e$ constitutes also a high resistance, the motor will absorb the least possible tension. This is preciseiy what is to be attained, because owing to the small current in the line *F*, the loss of E. M. F. is small. If the current in *F F* increases the electromotive force falls. But it also results that the brake acts, and the current in the motor follows preferably the branch *I L g I I*. The number of lines of force and the contrary electromotive force of the motor diminish, so that the motor absorbs less E. M. F.

When the current in *F* is at maximum, *m g I g* is nearly equal to *m e I e*. The number of lines of force can be neglected, or, in other words, the armature is nearly at rest. The distant tension does not then sensibly differ from the normal tension if that in *A* and *B* is kept constant.

The foregoing are the chief among the methods devised by M. Lahmeyer for the purpose of maintaining constant speed with motors and constant E. M. F. or current in electrical distribution. I may presently return to this subject, showing what has recently been done by others.

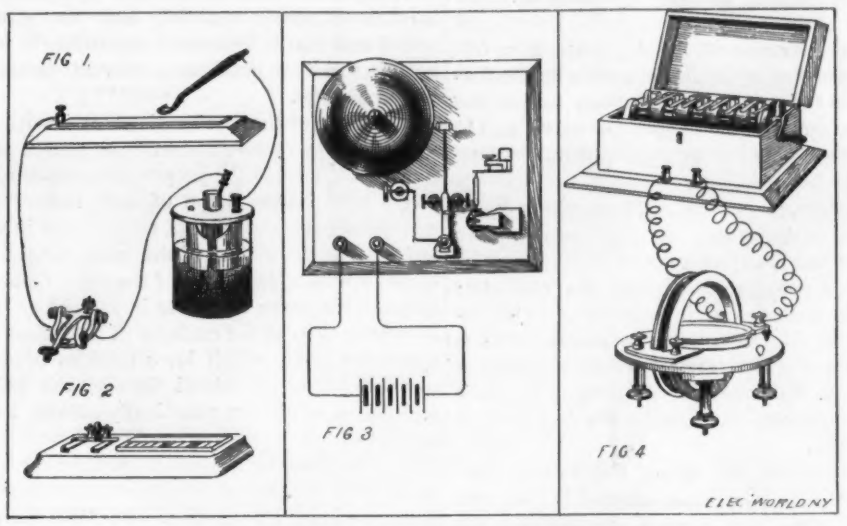


FIG. 35.—EDISON'S ELECTRO-MOTOGRAPH.

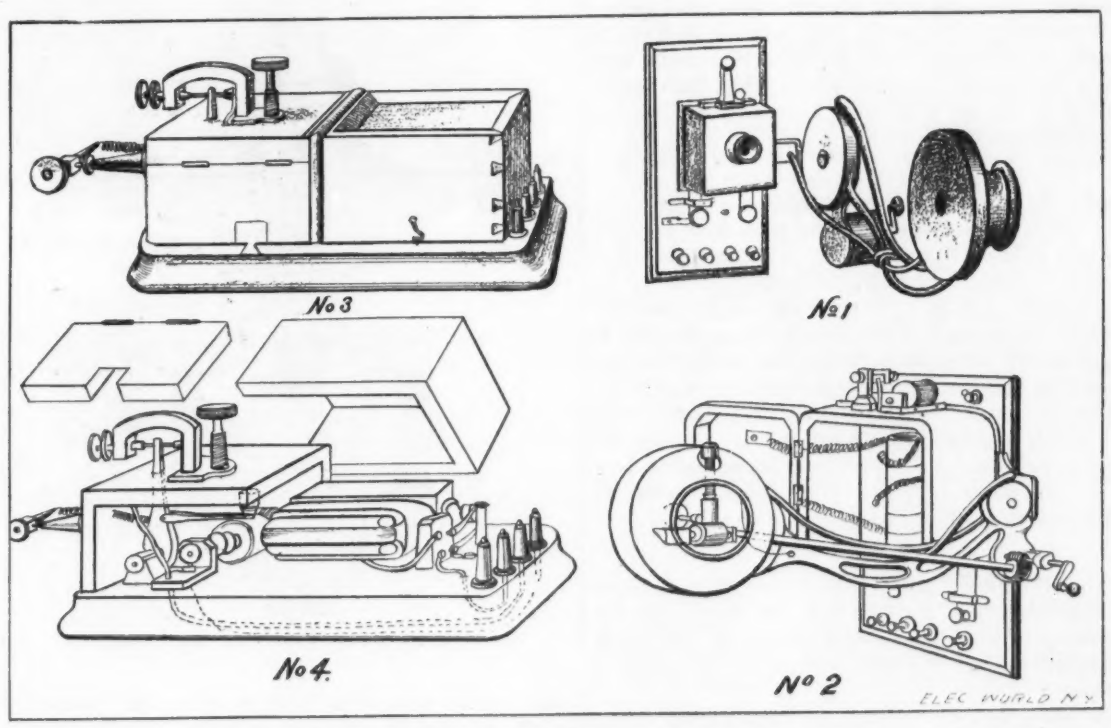


FIG. 36.—EDISON ELECTRO-MOTOGRAPH RECEIVER.

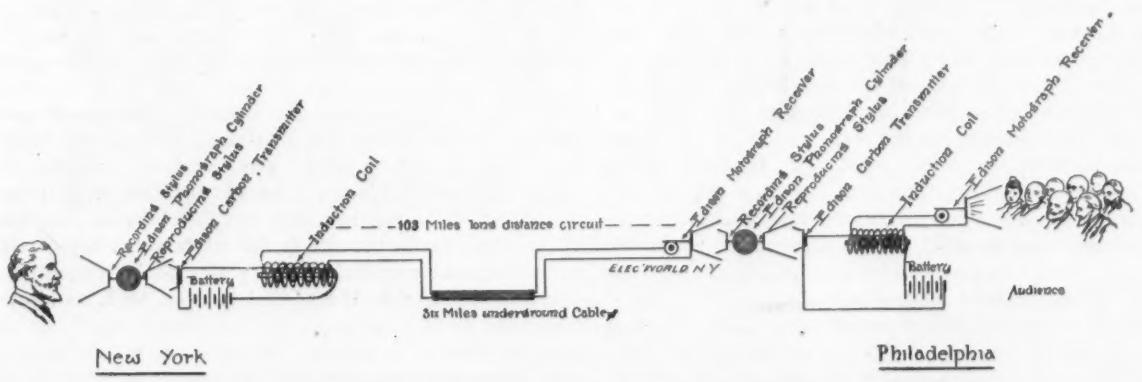


FIG. 37.—LONG DISTANCE TELEPHONY WITH THE PHONOGRAPH, ETC.

Edison and His Inventions at the Paris Exposition.—VII.

BY W. J. HAMMER.

(*Copyright*, 1889.)

ELECTRO-MOTOGRAPH.

One of the most curious of Mr. Edison's discoveries, and one which he has applied in quite a number of his inventions, is what he calls his "electro-motograph principle," illustrated by diagram 1, Fig. 35. He found by placing a sheet of slightly roughened paper, saturated with certain chemical solutions, upon a brass plate which was connected to one pole of a battery, that by passing over the paper a piece of sheet metal (preferably of palladium, although lead, thallium and platinum are effective) which was connected to the other pole of the battery with a telegraph key introduced in the circuit, that as he opened and closed the key, there was an alternate friction and slipping of the strip upon the paper, the passage of the current of the electricity producing a lubricating effect.

MOTOGRAPH RELAY.

The electro-motograph principle Mr. Edison employed is found in his motograph relay which he sold to the Western Union Telegraph Company for $100,000 in cash at the time of the war between that company and the American Union Telegraph Company, at which time the Western Union controlled the Paige patent for the electro-magnetic relay, which was the only principle under which a telegraph relay could be operated. The Western Union purchased this invention to keep it out of the hands of their dangerous rivals, with whom, however, they effected a consolidation a few weeks afterward, and then, having their lines already equipped with the Paige relay, the Edison was put among the archives.

In this instrument, as in his electric motograph telephone, he employed a cylinder of chalk in place of the strip of chemically treated paper, the chalk occasionally needing a moistening with distilled water, applied with a camel's hair brush. The relay, as shown in diagrams 3 and 4 and Fig. 36, represents the palladium-faced pen resting upon the chalk cylinder and attached to the upright brass rod, restrained by an adjustable spring, and which vibrated between the contacts controlling the throwing of the local battery into circuit as the impulses sent over the main line produced the corresponding periods of friction and lubrication of the pen on the chalk. As Mr. Prescott, who has published such admirable treatises upon Mr. Edison's work in his books upon telegraphy, the telephone and the electric light expresses it, "it is a substitution of friction and anti-friction for electro-magnetism in the relay."

Mr. Edison has constructed these relays, which have worked through a million ohms resistance, which, with the battery employed was too high for an electro-chemical apparatus with iodide of potassium, and sufficiently high to give no deflection on an ordinary galvanometer. The chalk in this instrument is revolved by means of a tiny electric motor.

THE MOTOGRAPH RECEIVER.

In the Edison motograph receiver, or loud-speaking telephone, as seen in diagrams 1 and 2, Fig. 36, the chalk is revolved generally by hand, and in some cases by a small electric motor. The palladium-faced pen or spring which rests on the chalk is attached to a mica diaphragm in a resonator. The current passes through the pen from the main line to the chalk and to the battery. This wonderful instrument reproduces the voice with remarkable power and distinctness, and, arranged as in his

"Belcher telephone," may be heard perfectly by an audience of 5,000 people.

In employing this receiver in conjunction with the ordinary Edison carbon transmitter, the sound waves impinging upon the latter vary the resistance of the carbon button contained therein, causing a consequent variation in the current from the battery that passes through the primary of an induction coil. The current induced in the secondary of the coil passes over the line, and causes variations in adhesion of the metallic strip on the chalk cylinder of the motograph receiver, and therefore causes mechanical vibrations of the diaphragm which reproduces the speaker's voice.

Mr. Edison, possessing his carbon transmitter and his motograph receiver, had a perfect system of telephony, while Bell had only his electric-magnetic telephone, perfect as a receiver, but practically useless as a transmitter.

In England Edison forced Bell into a consolidation called the Edison-Bell Telephone Company of Great Britain, which employs Edison's transmitter and Bell's receiver, and to-day it is a well known fact that the company holds its European patents not on Bell's inventions, which were declared invalid, but upon Edison's, which were upheld. This is also the case on the Continent.

Turning to our own country, it is interesting to note that Edison's carbon transmitter, which he placed in the hands of the "Western Union Telegraph Company" in the early days of the telephone, and for which they pay him $6,000 royalty per year, is the same instrument used by the Bell Telephone Company to-day, who pay the "Western Union" over $400,000 royalty per year. Mr. Edison says it is all right, but the fact is interesting, nevertheless.

CHALK BATTERY.

In diagram 4, Fig. 35, is shown Mr. Edison's motograph, or chalk battery. It consists, as shown, of a series of chalk cylinders, mounted on a shaft which rotates by hand. Resting upon each chalk is a palladium-faced spring, and similar springs rest upon the shaft between each chalk. By connecting all these springs in series, in circuit, with a sensitive galvanometer, and turning the handles rapidly, a considerable current indication is manifested. It has yet been undetermined as to what this is due.

In conclusion let me state that Mr. Edison is still a young man. He will be but 42 years of age one week from to-night, Feb. 11, and judging from the fact that his ancestors were noted for their longevity, and judging from his present excellent health, his wonderful constitution and capacity for hard work, it is reasonable to expect that he will be spared yet many years to bless the world with discoveries and inventions of as great and greater import than those of the past, and when the curtain rings down upon the close of this wonderful nineteenth century of ours, the name which will shine out with the greatest lustre from the roll of those whose deeds live after them will be the name of Thomas Alva Edison.

I now show in operation the old and new styles of phonograph, Edison's talking doll, etc. I also show you the most remarkable experiments ever shown in connection with the telephone and the phonograph. These consist of the following:

1st. Recording on a phonograph in Philadelphia music and talking transmitted over the long distance telephone line from New York, and reproducing same to the audience.

2d. Recording music and talking upon the Philadelphia phonograph, which is talked into the long distance telephone by a phonograph in New York.

3d. Reproducing to the audience by means of Mr. Edison's motograph receiver or loud-speaking telephone and Edison's carbon transmitter the music and talking registered on the Philadelphia phonograph, which is sent over the long distance telephone line from New York (a distance of 103 miles) by the New York phonograph. This wonderful experiment employs two Edison phonographs, two Edison carbon transmitters and two Edison motograph receivers acting in juxtaposition with 103 miles of telephone wire, 6 miles of which is underground (Fig. 37). In view of such experiments as these will it be too much to say that in the future it may be possible by employing phonographs in the capacity of relays for a man to whisper in his own ear around the circumference of the earth? It is to-day practicable over hundreds of miles, and who says we shall not some day transmit audible speech across the sea? By mailing the cylinders, this is to-day accomplished.

One more experiment which I wish to call your attention to, and which I have demonstrated as feasible, is this. A phonograph in Paris can sing the "Marseillaise" over a telephone line and record it upon a phonograph cylinder at Berlin at the same moment that a phonograph in Berlin is transmitting "Die Wacht am Rhein" over the line and recording it upon the cylinder in Paris. When they are both ended, both songs will be upon both cylinders, thus demonstrating a new method of exchanging international courtesies.

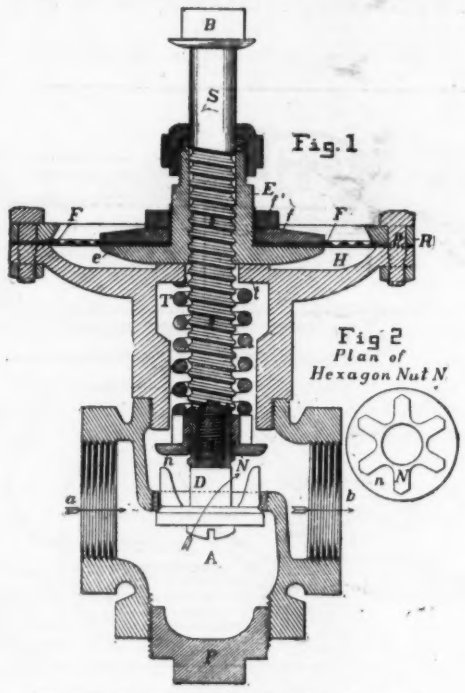
A Neat Telephone Trick was played recently in Chicago, when, by calling up a clerk on the telephone just as he was counting money for a pay roll, sneak thieves contrived to get away with $2,870, which the clerk had left in a package on his desk while he struggled with the message.

Foster Improved Steam Pressure Regulator.

In the accompanying figure we illustrate the Foster improved pressure regulator, which is a device specially designed for maintaining the steam delivery pressure constant under wide variations of boiler pressure, and is of great utility for the purpose of maintaining constant delivery pressure at the engines running dynamos or other machinery.

The principle of the operation of the regulator is as follows: The delivery pressure of the fluid bearing on the diaphragm tends to close the valve; in opposition to this, the spring bearing on the nut *N* tends to open the valve, and to get perfect results there should be an equilibrium between these two forces. Under these conditions if the delivery pressure falls, the pressure on the diaphragm is reduced and allows the spring to open the valve and admit more steam. On the other hand, any increase of delivery pressure operating on the diaphragm overcomes the resistance of the spring, and the valve closes in proportion to the increased pressure. The only adjustment requiring care is the spring, the tension of which is regulated by the position of the hexagonal nut *N*. This nut has a flange *n* on its lower side, which is used to prevent an excessive lift and possible bulge of the diaphragm.

To increase the tension on the spring the valve is first opened a couple of turns, and the hexagonal nut *f'* loosened, and with a wrench applied to hexagon *E*, the stuffing box in the direction indicated by the arrow on the name plate. To decrease the tension on the spring the stuffing box is turned in the opposite direction to that indicated by the arrow, after which the jamb nut *f'* is tightened. One-half of



FOSTER STEAM PRESSURE REGULATOR.

a turn, either way, is the limit to which the stuffing box should be moved. These regulators are manufactured solely by J. M. Foster & Co., of this city.

Some Points About Storage Battery Plates.

BY E. R. KNOWLES.

In addition to the question of the density of the active material in storage battery plates, as discussed in a former article, there are other points which arise, such as the best shape to make the plate, its best dimensions, the shape of the perforations in the plates, the metal from which the plates are made, the method of connecting the plates together, and the character of the active material employed to fill the perforations in the plates. On all these points there is wide diversity of opinion, and it is the writer's purpose to state such results as are the outcome of his own personal experience. In the first place, as to the plate itself, its shape and dimensions. Almost every conceivable shape has been devised and tried, but it seems to be generally conceded that a rectangular shape, approximately square, is the best shape. One objection that may be urged to a deep plate is that immersing in the electrolyte, which has a tendency to become more dense at the bottom of the plate than at the top, subjects the plate to different degrees of chemical action at different parts of its surface, and a long, rectangular plate has been urged by some to be a better form. This style of plate takes up unnecessary room, and, being long and narrow, its tendency will be, unless well supported, to warp out of shape much more easily that the square form. The square plate seems to be the one most generally in use. As to the thickness of the plate there is also a diversity of opinion, some claiming that the plates should be as thin as possible, and a large number of plates to the cell, so as to expose as large a surface of active material as possible; while others prefer to have a few quite thick plates with a limited amount of surface of active material exposed, but with a large mass of active material. There is a proper mean between these extremes. Very thin plates are difficult to keep flat and true under the usage to which they are subjected in actual practice. They will warp and curl, no matter how many separators are placed between them. The plates should be thick enough to be rigid and able to withstand any tendency to bending or warping which may exist, exposing a reasonable amount of surface of active material, and yet containing enough active material in as dense a condition as is practicable to be able to give a maximum current discharge for a given period of time.

The shape of the perforations or cavities in the plates into which the active material is placed also plays a very important part in the proper proportioning of the plate. Every conceivable shape of hole has been used. Three general types cover most of them: those in which the hole is larger at the surface of the plate than it is at its centre, those in which the hole is of the same diameter all the way through the plate, and those in which the hole is larger at its centre than at the surfaces of the plate. Besides these there are plates which have cavities made in their surfaces which do not extend through the body of the plate, and plates which are practically hollow, having one large cavity, whose walls are perforated, and in which cavity the active material is placed. We have a regular evolution of the idea of a perforated plate, beginning with the smooth plate used by Planté, then the plate with the roughened surface, the small cavities so made getting gradually larger and deeper until their extremities come together and extend clear through the plate, when we have the perforations larger at the surfaces of the plate than they are at its centre. The central diameter of these holes gradually enlarges until we have them of uniform diameter throughout, giving the second type of perforation. The central diameter is then enlarged, and we have the third type of perforation, in which the diameter at the surfaces of the plate is smaller than the central diameter. Finally, we have the hollow plate, in which all the holes are merged into one large cavity, with perforated walls, the latest form of plate. The worst form of all is the one in which the perforation is largest at the surfaces of the plate and smallest at its centre. It is mechanically incorrect, for no matter how carefully the active material is placed in it, the slightest change in the bulk of the active material ultimately results in the plug splitting apart at its centre, loosening and being forced out of the plate. The straight hole, the one with the same diameter throughout its length, is much better and is largely in use. The best of these three forms is the one in which the central diameter is larger than at the surfaces of the plate, changes of bulk of the active material tending to make the plug fit more tightly. All plates made with perforations which extend clear through the plate are objectionable on account of the large amount of inactive metal that has to be left in the plate to the exclusion of active material. A form of plate which obviates in a great degree this difficulty is one which is practically hollow, consisting of two plates of thin, perforated metal with the active material placed in the cavity between them, the whole being fastened together in some suitable way. It would therefore seem that a square plate of reasonable thickness, which is practically hollow and filled with the active material, its walls being perforated, would be the best for practical purposes, it not being likely to warp or bend under ordinary conditions, nor to allow the active material to fall out, and offering a maximum of active material with a minimum of inactive metal.

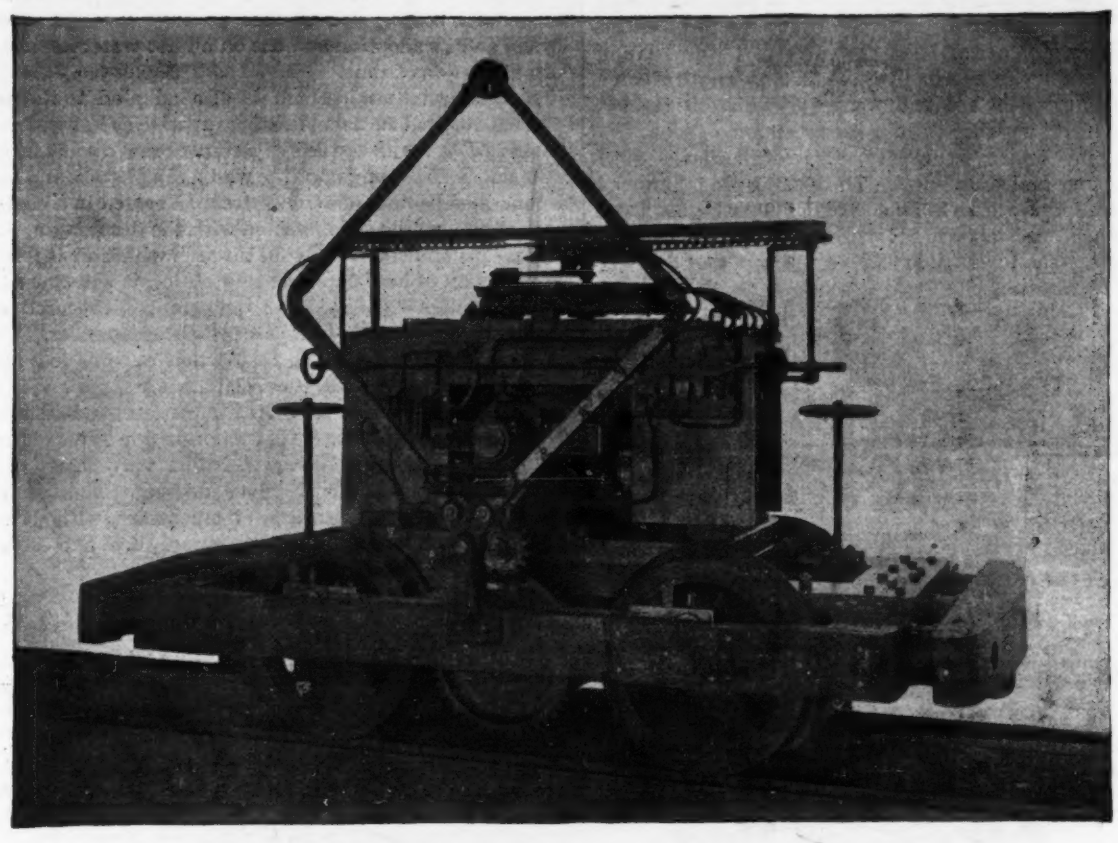
The character of the metal from which the plate is made is another important consideration. It should be of a character not altered by the chemical action which takes place in the cell during charge and discharge. A great many makers of secondary batteries use nothing but lead for the metal from which their plates are made. This is unsatisfactory, as every time the cell is charged and discharged a certain portion of the metal composing the positive plate is changed into active material, causing the plate to swell or grow and ultimately become entirely disintegrated and useless. It is also very soft and flexible and will warp and curl easily under the various strains to which they are subjected. An alloy of lead with other metals, which is not attacked by the chemical reactions which take place in the cell, is far preferable, being stiff and rigid, and permitting the plates to be made much lighter in weight than if made solely from lead, no allowance being needed for the constant corrosion which would take place with a lead plate. Whatever metal the plate is made from should be practically unattackable when in the electrolyte. In connecting a number of plates together to form a cell care should be taken not to connect them so rigidly that they will not be free to move, if necessay, under the varying conditions to which they may be subjected. Plates will expand and contract more or less when in use, and this must be allowed for in connecting them together. Some makers connect a set of plates rigidly together at more than one point. If any tendency to buckle exists, this only increases the difficulty. It would seem that one connection, along the tops of the plates, leaving the other portion of the plates practically free, would be the best. The plates should also be separated by elastic separators, which, while keeping the plates apart, still allow them to come and go as occasion may require. In other words, the

whole cell, while it is properly connected electrically, should still be elastic in its character, so as to readily conform to all the varying forces to which it may be subjected. The falling out of the active material, from a plate, is in the main due to the character of the material employed, whether it changes its bulk to any degree under the varying chemical combination through which it passes in active use. For instance, the different oxides of lead each occupy more space than the actual mass of the lead from which they are made; also, if one oxide is changed to another its mass increases or diminishes as the case may be. The same holds good when the oxides are changed to a sulphate—it occupies a larger space than the oxide from which it is made. Now if a plate is filled with an oxide, which in the process of formation is raised to a higher oxide or is sulphated, the new form of material will increase in bulk and tend to occupy a larger space than it did before formation. There will not be room enough in the plate for it, and something has ultimately got to give. Either the plate will warp or curl, or the active material will be forced out of the plate, or both results may take place.

It is sufficient to say that the active material must be put into the plate in such a form that these evils may not occur. This can be done, and done successfully, as the writer has amply demonstrated, and thereby nearly, if not all, of the tendency to warp and buckle, and the active material to fall or be forced out of the plate, be obviated. To sum up, then, a plate, of an inoxidizable alloy, of square or nearly square shape, of a proper thickness, approximately hollow, with its walls perforated and the active material of a proper kind and density placed in its interior, so arranged as to have a maximum of active material with a minimum of inactive metal, would seem by present experience to be the best form of plate, and a cell which, while connected so as to give sufficient conduction to electric currents, is yet elastic enough to accommodate itself to such variations as it may be subjected to, the best arrangement of cell.

Electrical Mining Operations at Scranton, Pa.

That the electrical current can be easily adapted to mining and engineering operations is a fact which is abundantly attested by mines in which it has already come into general use for both lighting and transmission of power. The contrast between the wire rope, compressed air and other methods, and electrical transmission of power, cannot fail to be in favor of the latter system. Existing water powers miles away from the mines may be used, and electric motors employed for hoisting, haulage, pumping, ventilating and many other purposes with greater ease and economy than could possibly be accomplished by any other method.

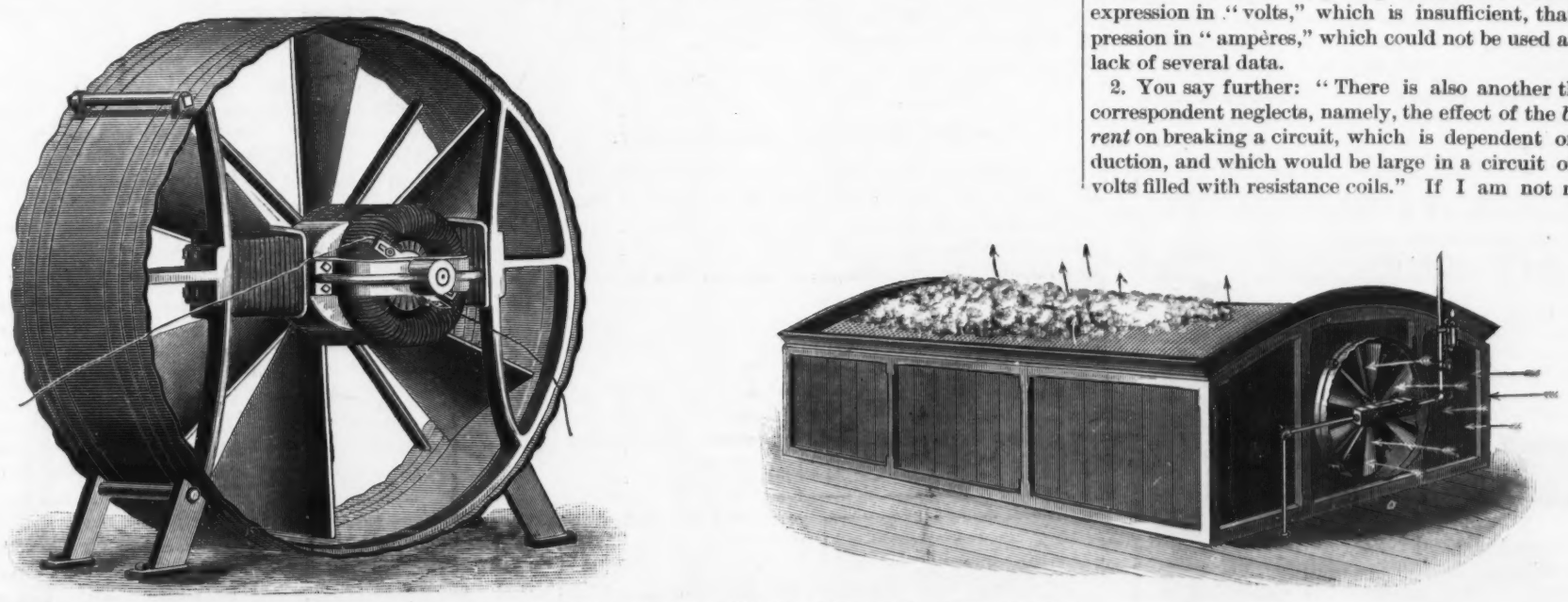


THOMSON-HOUSTON MINING APPARATUS, SCRANTON, PA.

The Thomson-Houston Electric Company has just completed a mining locomotive for the Hillside Coal Company, Scranton, Pa., which is shown in the accompanying illustration. The machine embodies new features in motor construction and in general design, and under practical test has shown that it is particularly adapted to the nature of the work required of it. The locomotive is made for operation on a three-foot gauge, is 9 feet 7 inches in length over all, width 5 feet 3 inches, and height 5 feet 6 inches. Although the weight is 10,500 pounds, there is not a pound of it which is not utilized in the construction of the machine, and the tests for traction which have been made have given the most excellent results. The speed is six miles an hour under full load.

The motor used is the type "G" railway motor, 40 h. p., embodying designs and inventions of Mr. Charles J. Van Depoele. Its motion is transmitted to the wheels by gears and connecting rods. On the top of the machine is placed a rheostat controlled by the wheel shown at each end, and on the side is placed a reversing switch which can be operated in the same way from either end.

One of the distinctive features is the trolley arm, which will operate with equal facility in either direction, and its method of construction permits a great variation in the height of the conductor. This is a very important and valuable feature, as in mining work the conductor is rarely maintained for any length at a constant height. The Thomson-Houston Electric Company has already made in mining operations many applications of its electrical apparatus, which has been found to possess the same characteristics of excellence as shown in its well-known lighting system.



FIGS. 1 AND 2.—WING DISC FAN AND MOTOR.

Wing's New Electric Disc Fan.

The application of electric motors to drive exhaust fans is of common occurrence, whenever an electric light circuit is accessible, and fans thus driven are to be found in all large buildings occupied by users of steam or heat in any form, or whenever a number of persons are gathered within a room, thus necessitating the employment of some method of artificial ventilation. An improved form of disc fan, with electric motors attached, and specially designed for heavy work, is shown in Fig. 1. A prominent feature claimed in the construction of these fans is that the blades are so placed that they do not shut out the light.

The application of the disc fan to the drying of wool, cotton, hair or grain is shown in Fig. 2. This dryer can be located at any desired point, and the electric wires run thereto, and can always be operated, at night time as well as during the day. By a small outlay in original cost and at trifling expense of running the fans, the usual drying rooms can be made to do double the amount of drying, and in many classes of goods, such as woolen, silk, moroccoes, etc., they come out much softer and in finer condition, and with less loss from shrinkage. These fans are made by the Simonds Manufacturing Company, of New York, with W. H. Wissing, General Western Agent, Chicago.

Shock in Terms of "Current."

To the Editors of The Electrical World:

I beg to refer you to your issue of Sept. 28, containing an editorial note concerning electric shocks, and make some observations in relation to it:

You say: "Mr. Gaillard objects to speaking of a shock as so many volts, and holds that it should be spoken of in terms of "current;" but we fail to see how either can be closely measured."

1. I agree with you in the latter particular. However, if we could make the close measurement of shocks, a shock expressed in "current" would represent exactly the intensity of the physiological effect produced on the body, whatever the resistance of contact may have been: while the shock expressed in "volts" would be meaningless, unless we give also the resistance of contact and the resistance of the body struck.

But, as you say, being, for the present, unable to measure accidental shocks, it is, perhaps, better for us to keep the expression in "volts," which is insufficient, than the expression in "ampères," which could not be used at all, for lack of several data.

2. You say further: "There is also another thing our correspondent neglects, namely, the effect of the *back current* on breaking a circuit, which is dependent on self-induction, and which would be large in a circuit of 100,000 volts filled with resistance coils." If I am not mistaken, though the electromotive force of self-induction depends on the primary electromotive force, the *current of self-induction* or back current depends before everything on the primary current, whatever the E. M. F. may be. So that, although a circuit formed of resistance coils may have a high self-induction coefficient, the back current will not be dangerous if the primary current is weak enough.

3. It is said further, in the same article, that the taking hold of the brushes of a dynamo generating 2,200 volts—contact being perfect—would subject the recipient to that pressure. If such is the case, I am at a loss to see where the current running through the armature will find any pressure left to keep itself up. The percentage of pressure for the last purpose would be unappreciable if the resistance of the human body was considerably high, compared with the resistance of a dynamo generating 2,200 volts. But is it the case, really?

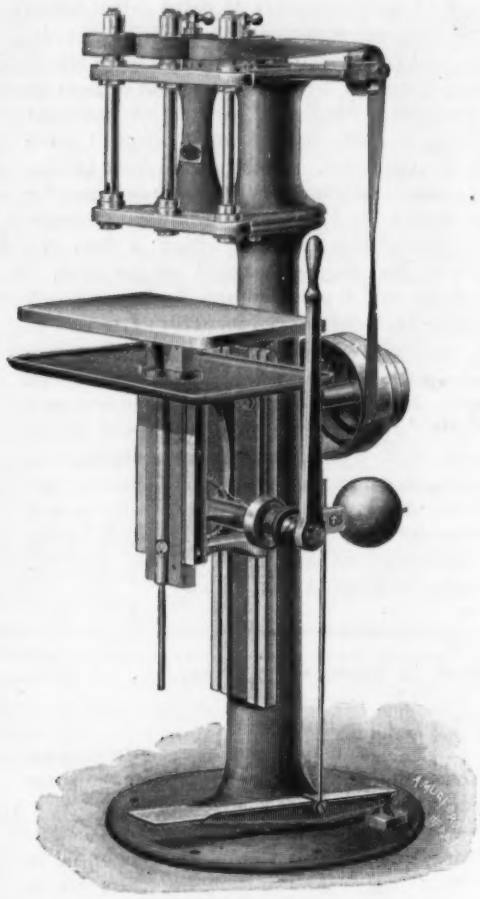
A. GAILLARD.

BOSTON, Mass.

Endless Belt Multiple Spindle Drill.

The illustration on this page of a three-spindle drill shows a design of a substantial tool brought out by the Dwight Slate Machine Company, of Hartford, Conn., that will meet the wants of drill users whose work renders it more desirable to have a movable table operated by hand or foot lever different from their standard line of "sensitive" drills.

The manufacturers claim this drill to be of novel design and greatly improved, especially in the manner of driving



ENDLESS BELT MULTIPLE SPINDLE DRILL.

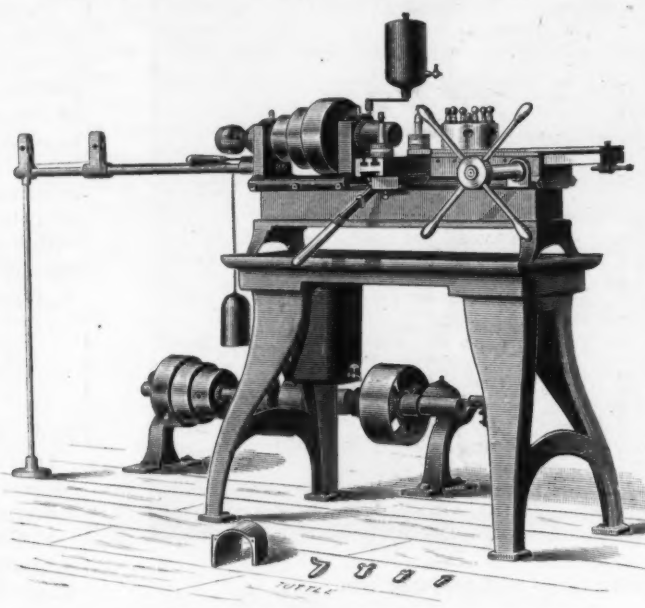
the spindles. To this tool the company have applied the patented device of Mr. Dwight Slate for driving the spindles.

As will be seen, all the spindles are driven by a single endless belt some 18 feet in length. To provide for the take-up of belt necessary from wear or change of atmosphere, two movable tightening pulleys are provided. The advantages of this arrangement are many. The single long belt takes the place of numerous short ones, and being endless (no lacing) runs smoothly, and the annoyance so usual of vibration caused by bungling lacings or flying lace ends, or oil in the face of the operator, is avoided. The belt has a contact of one-half to two-thirds of the circumference of the driving pulleys. This insures steady, continuous motion in spite of varying work, and gives the drill with a minimum of belt tension much greater driving power than can be obtained on straight open belts.

One other feature the company especially call attention to and that is the manner of driving spindles. This is accomplished by a feather and bushing in the upper end of the pulley hub that runs outside of spindles, but which pulley has its bearing on an ample sized fixed stud in the frame. This takes all strain from the spindle that is incident to belt tension when the pulley is placed on the spindle itself; and this same steady pull is what in ordinary drills elongates spindle bearings. The capacity of the drill shown is to drill holes from 0 to ⅝ inch in diameter. The spindle is steel, 1¼ inches in diameter, and chucked for Morse No. 2 taper. The spindles are 6½ inches from centre to centre, and will drill to centre of a 16-inch circle. The greatest distance from the bottom of spindle to top of table is 20 inches. The weight of the drill is 650 pounds. The Dwight Slate Company will shortly bring out a four and six spindle drill of the same general style.

Screw Machine With Pilot Feed.

The engraving represents a screw machine made by E. E. Garvin & Co., New York. This size of machine is made with and without wire feed, also with pilot or with lever feed. It is adapted for making screws ¼ to ⅝ inches diameter. In a machine of this kind studs of two or more diameters can be cut off from the rod, the ends rounded, threaded and head chamfered. Machine screws, washers, milled-head screws, etc., can all be turned out with the utmost rapidity and accuracy, and perfectly finished. Any length of screw can be made, as the hole in the turret goes directly through it. The turret has six holes for the reception of tools. The indexing mechanism for the turret is of hardened steel, and is strong and substantial. The locking pin is hardened and ground, and works in an adjustable taper bushing, and fits into hardened taper index sockets in the under side of the turret. The turret slide has a screw top, and the bearing block is readily adjusted along the bed. The cross slide has two tool posts, which are each provided with elevating collars, which give a fine parallel adjustment for tools. The slide is provided with a screw top. The spindle bearings are bronze cap boxes, and all sliding surfaces are scraped to a bearing. The cone is 8¼ inches diameter and has three speeds for 2¼-inch belt. There is a large reservoir in the bed of the machine, into which the oil drains and is drawn off at the bottom. The machine weighs 950 pounds.



SCREW MACHINE WITH PILOT FEED.

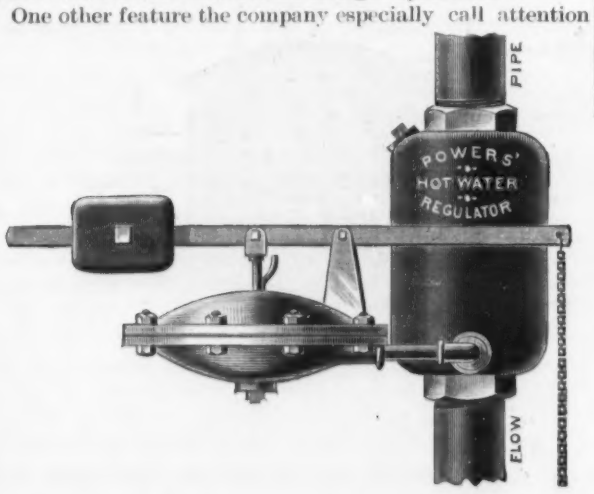
New Automatic Temperature Regulator.

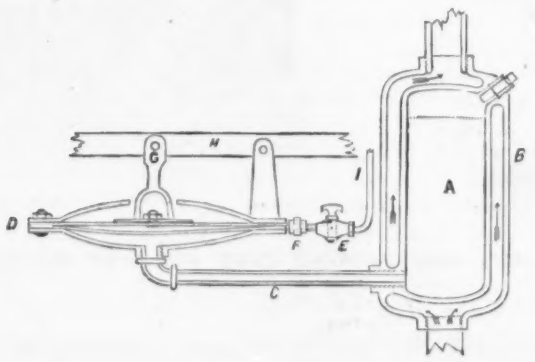
We illustrate in Figs. 1 to 4 a new temperature regulator, which has been devised and patented by Mr. W. P. Powers, of Chicago, for use in connection with hot water heaters, and which has attracted the favorable attention of architects and builders of fine residences during the past two years it has been on the market.

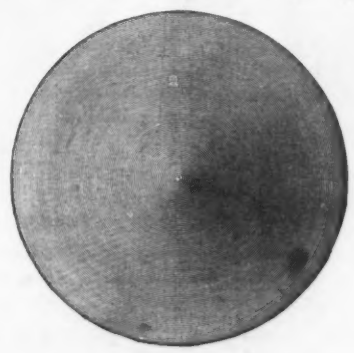
This temperature regulator has two distinct functions, one of which is to limit the degree of heat in the boiler at the highest point at which it can be carried without boiling over, which is accomplished by closing the damper automatically just before the boiling point of the circulating water is reached. The other is to close the dampers whenever the temperature of the house reaches the desired point to which the apparatus has been previously adjusted and open them whenever it falls below. The first result is secured by utilizing the well-known law that liquids under different pressures boil at different temperatures.

Fig. 2 shows the device in action, consisting of a shell *A* within a shell, the space between the two forming a part of the circulation, being located just above the boiler in one of the flow pipes, The inner shell communicates through a nipple with an ordinary diaphragm, such as is used on all low-pressure boilers. It contains water entirely separate from that of the circulation, it being introduced at the plug at upper right hand corner. This water being under atmospheric pressure, only boils at 212 degrees, while the circulating water will not boil until a higher temperature is reached. When the water in the heating system is raised above 212 degrees it causes the water in the interior shell *A* to boil, and the steam thus formed forces the water through the nipple and under the diaphragm, raising the lever and closing the damper. So the production of heat is stopped before the water of the heating system has reached its boiling point. It is an ingenious and simple device, and its adoption and use on all hot water heaters is only a question of time.

The thermostat used, which is also adapted to the control of steam and furnace heating as well as hot water, is shown in Fig. 3, and consists of a round brass disc 12 inches in diameter. It is hung upon the wall like a picture, and may be concealed behind one if desired. Located in a central room of the house and connected with the diaphragm, Fig. 2, by means of a small lead tube through which air is forced by the action of heat upon the thermostat, it will cause the damper to close when the right temperature is secured and open again at the least falling of the thermometer. This thermostat is so constructed that when exposed to a temperature above 60 degrees it expels the air contained in it, the pressure of the air, if confined, constantly increasing as the temperature rises. This action is due to a chemical substance contained therein, which is very sensitive to changes of temperature above 60 degrees. The result is said to be a perfectly uniform temperature, without any attention to the apparatus except to supply coal and remove the ashes.







FIGS. 1, 2, 3 AND 4.—POWERS' AUTOMATIC TEMPERATURE REGULATOR.

The Electrolytic Copper Industry.

The following important statement is from the *Iron Age* of this city:

For some time past rumors have been afloat that J. B. Haggin, who controls the Anaconda copper mine, of Montana, was contemplating the building of a plant to refine his own product electrolytically. It is now reported that the location for such a plant has been chosen, and that the project is to be carried out. If it is, the American copper market will be considerably affected by it. The Anaconda is the largest producer in the world, having in one year turned out over 60,000,000 pounds fine. From the smelting works of the company the metal is shipped in the form of a matte, which must be refined. Now, the American refineries were unable thus far to handle so large a quantity, so that the greater part of the matte had to be and is still shipped abroad. If it is to be treated at home a larger proportion will seek the home market.

The electrolytic process of refining copper has two very important advantages. First, it makes it possible to extract cheaply any silver which may be in the raw material, while the ordinary methods could pay only for anything above, say, $30 a ton. Butte City is also a great silver mining camp, and the ores being refractory, it pays to smelt them together with copper ores low in silver, making a rich product. That business has been done to a considerable extent at Butte, and has been growing, the Haggin interest itself having acquired considerable mining property with the object of developing this line of business. It will be seen, therefore, that a growing quantity of copper is becoming merely a carrier for the precious metals, and that this fact is tending to counterbalance to some extent the drawbacks to the Montana producers which grow out of a considerably lessened yield of their copper ore as greater depth is attained.

The second, and to consumers a very important consideration, in connection with the prospect of a large supply of electrolytic copper, is the quality, of that grade of metal. During the past few years considerable quantities of it have been on the market, and it has been pretty thoroughly tested by consumers. It has gone into mills where Lake and special Arizona brands only had access previously. It has stayed there. So far as we can learn it does not quite equal Lake for certain kinds of work, but it can be, and is, freely employed in its stead for other articles. That means that the great hold of the Lake companies has lost

much of its strength. It means that at no distant day the production of the best grades of copper is likely to be in excess of the demand, relatively; that, therefore, the differences in the price between the different grades must tend to lessen, and that consumers of the metal will have a better class of raw material to work with.

On the Propagation of Electric Waves Through Wires.*

BY PROF. H. HERTZ.

If a constant electric current flows in a cylindrical wire its intensity is the same in all parts of the section of the wire. But if the current is variable, self-induction causes a deviation from this most simple distribution, and the flow is confined to the exterior of the wire. If the current alters its direction a few hundred times per second, the deviation is no longer imperceptible, and increases rapidly with the rate of alternations, and when the current alternates many millions of times per second, according to theory, the flow must be confined to the immediate neighborhood of the circumference.

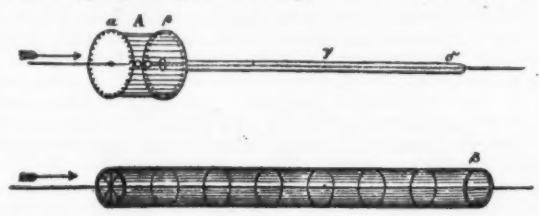
In such extreme cases we must take another view of the subject which was first put forward by Messrs. Heaviside† and Poynting‡ as the true interpretation of the equations of Maxwell as applied to this case. According to this view, the electric force which determines the current is in no wise propagated in the wire itself, but under all circumstances enters the wire from without and spreads itself in the metal comparatively slowly, and according to similar laws as changes of temperature in a conductor of heat. If the forces in the neighborhood of the wire are continually altering in direction, the effect of these forces will only enter to a small depth into the metal; the more slowly the changes take place, so much deeper will the effect penetrate; and if, finally, the changes follow one another infinitely slowly, the force has time to fill the whole interior of the wire with uniform intensity.

In whatever way we wish to regard the results of the theory, an important question is, whether it agrees with fact. Since, in the experiments which I carried out on the propagation of electric force, I made use of electric waves in wires which were of extraordinarily short period, it was convenient to prove by means of these the accuracy of the inferences drawn. In fact, the theory was proved by the experiments which will now be described; and it will be found that these few experiments suffice to confirm in the highest degree the view of Messrs. Heaviside and Poynting.

If a primary conductor acts through space upon a secondary conductor, it cannot be doubted that the effect penetrates the latter from without. For it can be regarded as established that the effect is propagated in space from point to point, therefore it will be forced to meet first of all the outer boundary of the body before it can act upon the interior of it. But now a closed metallic envelope is shown to be quite opaque to this effect. If we place the secondary conductor in such a favorable position near the primary one that we obtain sparks 5 to 6 millimetres long, and surround it now with a closed box made of zinc plate, the smallest trace of sparking can no longer be perceived. The sparks similarly vanish if we entirely surround the primary conductor with a metallic box. It is well known that with relatively slow variations of current the integral force of induction is in no way altered by a metallic screen. This is, at the first glance, contradictory to the present experiments. However, the contradiction is only an apparent one, and is explained by considering the duration of the effects. In a similar manner a screen which conducts heat badly protects its interior completely from rapid changes of the outside temperature, less from slow changes, and not at all from a continuous rising or lowering of the temperature. The thinner the screen is the more rapid are the variations of the outside temperature, which can be felt in its interior. In our case also the electrical action must plainly penetrate into the interior, if we only diminish sufficiently the thickness of the metal. We are brought, therefore, to the conclusion that what we call an induced current in the secondary conductor is a phenomenon which is manifested in its neighborhood but to which its interior scarcely contributes.

In Fig. 1 the two discs were placed so near together that they formed, with the wires inserted between them, a cage (*A*) just large enough for the reception of the spark-micrometer. One of the discs, α, remained metallically connected with the central wire; the other, β, was insulated from the wire by means of a circular hole through its centre, at which it was connected to a conducting tube, γ, which, insulated from the central wire, surrounded it completely for a length of of 1.5 metre. The free end of the tube, δ, was then connected with the central wire. The wire, together with its spark-gap, is once more situated in a metallically protected space; and it was only to be expected, from the previous experiments, that not the slightest electrical disturbance would be detected in the wire in whichever direction waves were sent through the apparatus. Very thin brass tubes, tubes of tinfoil and Dutch metal proved to be perfect screens when used to replace the metallic tube γ. I now took glass tubes which had been silvered by a chemical method, and it was then perfectly easy to insert tubes of such thinness that, in spite of their protecting power, brilliant sparks occurred in the central wire. But sparks were only observed when the silver film was no longer quite opaque to light and was certainly thinner than $\frac{1}{100}$ millimetre. In imagination, although not in reality, we can conceive the film drawn closer and closer round the wire, and finally coinciding with its surface; we should be quite certain that nothing would be radically altered thereby. However actively, then, the real waves play round the wire, its interior remains completely at rest; and the effect of the waves hardly penetrates any more deeply into the interior of the wire than does the light which is reflected from its surface. For the real seat of these waves we ought not to look, therefore, in the wire, but rather to assume that they take place in its neighborhood; and instead of asserting that our waves are propagated in the wire, we should be more accurate in saying that they glide along on the wire.

We can conclude from the above results that rapid electric oscillations are quite unable to penetrate metallic sheets of any thickness, and that it is, therefore, impossible by any means to excite sparks by the aid of such oscillations in the interior of closed metallic screens. If, then, we see sparks produced by such oscillations in the interior of metallic conductors, which are nearly, but not quite, closed, we shall be obliged to conclude that the electric disturbance has forced itself in through the existing openings. This view is also correct, but it contradicts the usual theory in some cases so completely that one is only induced by special experiments to give up the old theory in favor of the new one. We shall choose a prominent case of this kind, and by assuring ourselves of the truth of our theory in this case, we shall demonstrate its probability in all other cases. We again take the arrangement which we have described in the previous section and drawn in Fig. 1; only we now leave the protecting tube insulated from the central wire at δ. Let us now send a series of waves through the apparatus in the direction from A toward δ. We thus obtain brilliant sparks at A; they are of similar intensity to those obtained when the wire was inserted without any screen. The sparks do not become materially smaller, if, without making any other alteration, we lengthen the tube γ considerably, even to 4 metres. According to the usual theory it would be said that the wave arriving at A penetrates easily the thin, good-conducting metal disc α, then it leaps across the spark-gap at A, and travels on in the central wire. According to our view, on the contrary, we must explain the phenomenon in the following manner: The wave arriving at A is quite unable to penetrate the metallic disc; it therefore glides along the disc over the outside of the apparatus and travels as far as the point δ, 4 metres away. Here it divides, one part, which does not concern us at present, travels on immediately along the straight wire, another bends into the interior of the tube and then runs back in the space between the tube and the central wire to the spark-gap at A, where it now gives rise to the sparking. That our view, although more complicated, is still the correct one, is proved by the following experiments: Firstly, every trace of sparking at A disappears as soon as we close the opening at δ, even if it be only by a stopper of tinfoil. Our waves have only a wave-length of 3 metres; before their effect has reached the point δ the effect at A has passed through zero and changed sign. What influence, then, could the closing of the distant end δ have upon the spark at A, if the latter really happened immediately after the passage of the wave through the metallic wall? Secondly, the sparks disappear if we make the central wire terminate inside the tube γ, or at the opening δ itself; but they reappear when we allow the end of the wire to project even 20 to 30 centimetres only beyond the opening. What influence could this insignificant lengthening of the wire have upon the sparks in A, unless the projecting end were just the means by which a



FIGS. 1 AND 2.—PROPAGATION OF ELECTRIC WAVES.

part of the wave breaks off and penetrates through the opening δ back into the interior? Thirdly, we insert in the central wire between A and δ a second spark-gap B, which we also completely cover with a gauze cage like that at A. If we make the distance of the terminals at B so great that sparks can no longer pass across, it is also no longer possible to obtain visible sparks at A. But if we hinder in like manner the passage of the spark at A, this has scarcely any influence on the sparks in B. Therefore the passage of the spark at B determines that at A, but the passage of a spark at A does not determine that at B. The direction of propagation in the interior is therefore from B toward A, not from A to B.

We can, moreover, give further proofs, which are more convincing. We may prevent the wave returning from δ to A from dissipating its energy in sparks, by making the spark-gap either vanishingly small or very great. In this case the wave will be reflected at A, and will now return again from A toward δ. In doing so, it must meet the direct waves from δ to A and combine with them to form stationary waves, thus giving rise to nodes and ventral segments. If we succeed in proving their existence, there will be no longer any doubt as to the truth of our theory. For this proof we must give somewhat different dimensions to our apparatus in order to be able to introduce electric resonators into its interior. I therefore led the central wire though the axis of a cylindrical tube 5 metres long and 30 centimetres diameter. It was not constructed of solid metal, but of 24 wires arranged parallel to each other along the generating surface, and resting on seven equi-distant and circular rings of strong wire, as shown in Fig. 2. I made the requisite resonator in the following manner: A closely-wound spiral of 1 centimetre diameter was formed from copper wire 1 millimetre thickness; about 125 turns of this spiral were taken, drawn out a little, and bent into a circle of 12 centimetres diameter; between the free ends an adjustable spark-gap was inserted. Previous experiments had shown that this circle responded to waves 3 metres long in the wire, and yet it was small enough in size to admit of its insertion between the central wire and the surface of the tube. If now both ends of the tube were open, and the resonator was then held in the interior in such a way that its plane included the central wire, and its spark-gap was not directed exactly inward or outward, but was turned toward one end or the other of the tube, brilliant sparks of $\frac{1}{2}$ to 1 millimetre length were observed. On now closing both ends of the tube by four wires arranged crosswise and connected with the central conductor, not the slightest sparking remained in the interior, a proof that the network of the tube is a sufficiently good screen for our experiments. The end of the tube on the side β, that, namely, which was furthest away from the origin of the waves, was now removed. In the immediate neighborhood of the closed end, that is at the point α, which corresponds to the spark A of our previous experiments, there were now no sparks observable in the resonator. But on moving away from this position toward β, sparks appeared, became very brilliant at a distance of 1.5 metres from a, then decreased again in intensity, they almost entirely vanished at 3 metres distance from α, and increased again until the end of the tube was reached. We thus find our theory borne out by fact. That we obtain a node at the closed end is clear, for at the metallic contact between the central wire and the surface of the tube the electric force between the two must necessarily vanish. It is different when we cut the central conductor at this point just near the end, and insert a gap of several centimetres length. In this case the wave will be reflected in a phase opposite to that of the previous case, and we should expect a ventral segment at α. As a matter of fact we find brilliant sparks in the resonator in this case; and they rapidly decrease in strength if we move from α toward β, they almost entirely vanish at a distance of 1.5 metre, and become brilliant again at a distance of three metres; moreover, they give a second well-marked node at 4.5 metres distance, that is, 0.5 metre from the open end. The nodes and loops which we have described are situated at fixed distances from the closed end, and alter only with this distance. They are, however, quite independent of the occurrences outside the tube, for example, of the nodes and loops formed there. The phenomena occur in exactly the same way if we allow the wave to travel through the apparatus in the direction from the open to the closed end; their interest is, however, smaller, since the mode of transmission of the wave deviates from that usually conceived, less in this case than in the one which has just been under our consideration. If both ends of the tube are left open with the central wire undivided, and stationary waves with nodes and loops are now set up in the whole system, there is always found, for every node outside the tube, a corresponding node in the interior; which proves that the propagation takes place inside and outside with, at any rate approximately, the same velocity.

On looking over the experiments which we have described, and the interpretation put upon them, as well as the explanations of the physicists referred to in the introduction, a difference will be noticed between the views here put forward and the usual theory. According to the latter, conductors are represented as those bodies which alone take part in the propagation of electrical disturbances; non-conductors are the bodies which oppose this propagation. According to our view, on the contrary, all transmission of electrical disturbances is brought about by non-conductors; conductors oppose a great resistance to any rapid changes in this transmission. One might almost be inclined to maintain that conductors and non-conductors should, on this theory, have their names interchanged. However, such a paradox only arises because one does not specify the kind of conduction or non-conduction considered. Undoubtedly metals are non-conductors of electric force, and just for this reason they compel it under certain circumstances to remain concentrated instead of becoming dissipated, and thus they become conductors of the apparent source of these forces, electricity, to which the usual terminology has reference.

* Abstract from London *Electrician*.

† Oliver Heaviside, *The Electrician*, January, 1885; *Phil. Mag.* (5), XXV., p. 153 (1888).

‡ J. H. Poynting, *Phil. Trans.*, II., p. 277 (1885).

Electro-Physiology.

(*Concluded.*)

BY L. D'ARSONVAL.

Nature of the electrical phenomena which are produced in living beings.

All living beings are the seat of electrical manifestations. The origin of animal electricity has been especially studied in two tissues, the nerves and the muscles. It is certain, nevertheless, that its production is much more general and accompanies all vital processes. Electro-genesis must be, like thermo-genesis, a cellular phenomenon due to the same cause—the respiratory combustions correlative of life.

The living tissues present two kinds of electric manifestations, which do not appear to recognize the same source of production.

It is necessary to distinguish

(1) The *continuous* electrical manifestations, which are also called currents of repose.

(2) The *intermittent* electrical manifestations or currents of action.

Currents of action have this feature to remark, that in certain cases (electric eels) they behave as if true discharges of considerable intensity were obtained. Furthermore, these currents do not appear to pre-exist in the tissues, which are their seat, but to take place at the same moment as the organ enters upon its function.

The laws which regulate the production of continous currents have been well studied, for the nerves and muscles, separate from the body. To study these currents, it is necessary to employ special instruments with non-polarizable electrodes, dead-beat galvanometers or Lippmann's electrometer.

We do not yet know as an absolute fact if the "repose currents" of the muscles pre-exist, or if they arise from some circumstances specially belonging to the condition, or method of preparation, such as wounding of the muscles. Experiment shows clearly that if the surface of the muscle is absolutely intact, it does not yield any evidence of electric tension, or but very slightly.

All we can say is that the electrical manifestations in the muscles and nerves are extremely regular, and are certainly based upon the chemical and physical constitution of the contractile body. In this connection they have a great physiological interest.

These differences of pressures which are set up in a closed circuit at the surface of the muscle have, as their origin, chemical actions. This affirmation is evidently only another way of explaining the laws of the conservation of energy, but may be demonstrated by the following experiments:

1. The differences of tension diminish in the isolated muscles at the same time with its excitability; when this latter disappears all trace of regular current also disappears.

2. This current is weakened and disappears momentarily in the anæsthesia of the muscle by ether, that is in obstructing the chemical function of the protoplasm. All the continuous electrical manifestations in living material are not, in our opinion, due to chemical action as the immediate cause.

We can obtain continuous currents by means of purely physical phenomena which take place in the body.

1. By the simple filtration of a liquid without chemical action, across a porous septum, the converse in fact of Porret's experiment.

2. The passage of a liquid in a tube.

3. The experiments devised by the elder Becquerel, under the name of electro-capillary currents, etc. Far more interesting are the intermittent electrical manifestations, which have their seat in the living tissues.

If we excite a muscle by any irritant we find:

1. That every excited point becomes negative to the unexcited muscular substances.

2. That the speed of propogation of this negative wave is the same as that of the propogation of the muscular

wave (about three meters a second for a muscle of a frog treated with curare).

3. That this negative wave exists as long as the contractile wave.

4. That the electromotive force of the negative wave or of the current of action may attain the value of that of repose (.1 Daniell), which it never exceeds.

This current of action (also called negative variation or oscillation, but wrongly so) is sufficiently intense to excite a nerve or even a muscle in which it takes place (the induced contraction of Matteucci). The laws of the current of action in a nerve are the same as those of the muscle. The electromotive force is only weaker than in the case of the muscle (.02 to .03 of a Daniell's cell in the case of mammifers).

We cannot say that the currents of action are the result of that method of preparation, as we can easily prove at each beat of the heart, in the case of man and the mammifers, by using the arrangement indicated by Mr. Augustus Waller (1888). These currents attain an extraordinary intensity in the discharge of the electric organs of certain fish (*torpedo, gymnotus, silurus*, etc.).

The electricity is not already formed in these organs; we cannot liken it to a condenser or a battery since in a state of repose it does not show any outside electrical pressure, which is comparable to the energy of the discharge. These organs then produce electricity only at the moment when they enter on their functions at the will of the animal. They behave, as regards the production of electric energy exactly as the muscle does in performing mechanical energy, according to the beautiful analysis made by M. Marey. The nervous system no more causes electricity in the electric organ, than mechanical force in the muscle, since the discharges are obtained after the separation of the organ from the nerve centres, just as in the case of the muscle.

If contractility is the property of the muscle, electricity (to employ a corresponding expression) is in the same sense the property of the electric organ.

As yet no satisfactory theory has been given as to the origin of these currents of action. We encounter more or less ingenious hypotheses which give us fantastic molecular groups, of which we change the disposition with the requirements of the case. M. d'Arsonval has attempted an explanation, resting on a physical basis, bringing in the remarkable laws discovered by M. Lippmann, and which establish a relation between the capillary and electric phenomena in the inorganic world. M. d'Arsonval has shown that a relation of this kind exists between animal electricity and surface tension. All the phenomena actually known can be accounted for by this explanation.

The effects of continuous and alternating currents on animals. Electrolysis of the tissues. Precautions to be taken.

Some direct experiments have been made on different animals (guinea-pigs, rabbits, dogs), using a current derived from the following sources :

1. A static machine (4-plate Holtz), charging a battery of nine large jars.
2. A battery of 420 volts.
3. Continuous current Gramme machines of 120 to 8,000 volts.
4. Alternating current Gramme machines of 300 volts mean potential.
5. Induction coils and etxra currents, worked by accumulators.

These experiments have led the author to the following conclusions (d'Arsonval, Academy of Sciences, 4th April 1887) :

From what has been said before, a living being is above all sensible to a variable state of the current, from which it follows that at a mean equal pressure alternating currents are much more dangerous than continuous currents.

The various effects of electricity on living beings can be divided into two special categories, which comprehend them all. Electricity effects death from the two following causes:

1. By direct action (disruptive effects of the discharge, which act mechanically to destroy the tissues).

(2) By reflected or indirect action (in acting on the nerve centres, the irritation of which leads to a variety of inhibitory processes known since researches of M. Brown Sequard, undef the name of inhibition and dynamogénée,"

The static discharge is not fatal unless it strikes the respiratory centre directly, with well localized discharges, whose energy corresponds to about three kilogrammetres,

A. Under these conditions the different tissues (nerves) blood, muscles, etc.) struck separately by the discharge lose their physiological properties without possible return.

B. With a battery of 420 volts death is only caused by long repeated interruptions of the current. Death is due to a condition of tetanus produced by the current, and is accompanied by a considerable rise of temperature, which is the real cause of death.

C. The Gramme continuous current machine (110 volts) is only dangerous by the extra current on breaking circuit. Compound machines have less destructive effects at equal E. M. F., for the second coil serves as a shunt at the moment of rupture.

With an 8,000 volt machine, a momentary closing of the current made the animal (a rabbit) give a great jump, but did not cause immediate death; it was necessary to apply it a second time. (Experiment made in 1888 at the shops of the Gramme Company).

D. An alternating Gramme machine only caused death when above 120 volts mean potential.

E. A coarse-wire extra current coil is more dangerous than an induction coil, especially if it is connected to a condenser. The danger from a single discharge is defined only by the electric curve of this discharge. The knowledge of the difference of potential and the mean current intensity does not suffice. We must know in most cases, other things being equal, the duration of this discharge. For equal energy the danger is inversely proportional to this duration. It is the same with alternating currents, in which it is necessery to take account of the number of alternations per second. The separation into two groups of the effects produced by electricity at high potential, has a great practical value in the sense that in the first case death is certain and instantaneous (destruction with laceration of tissues), while in the second (death by irritation of the nerve centres without destruction) we can often restore life by employing artificial respiration immediately after the accident.

A continuous current of feeble intensity applied to the nerves brings on a modification of excitability, known by the name of electrotonus, and into the details of which we cannot enter here. This modification seems to depend solely upon the polarization caused by the passage of the current between the cylindrical axis and the marrow of the nerve, for it does not exist or only feebly so, in nerves deprived of marrow.

The passage of a continuous current of an intensity varying from 10 to 250 milliampères in the tissues of the organism is accompanied by electrolytic phenomena, used chirurgically by Chriselli, of Crèmona, to destroy the tissues without the effusion of blood. This famous method, introduced into France by Tripier, appears susceptible of giving excellent results in skilled hands. The passage of the current in this case acts as a local caustic, depositing the acids in a nascent state at the positive pole and the bases at the negative pole. In fact, electricity plays the part of a carrier of caustic acids and alkalines while localizing their action to the neighborhood of the poles. The cauterization at the positive pole gives rise to hard and retractile cicatrices; the opposite will be the case for the cauterization of the negative pole, according to Tripier.

It still remains to determine experimentally what are the intensities that it is useless or dangerous to employ, but the current may be the cause of general disorders when its intensity, that is to say its density at certain points, acquires a value exceeding an ampère.

Magnetic Leakage.

The magnetic leakage of certain forms of field magnets has been recently examined by Prof. H. S. Carhart, of Ann Arbor University, Mich. Two machines were examined, one of the Mather type of 500 watts capacity, constructed by one of the students, and the other a No. 2 Edison, capable of generating 5,000 watts.

The leakage of the first machine was due to four steel studs. supporting brass yokes forming the journals, and four iron bolts attaching the magnet to the wood base. The result of rectifying these errors was an apparent gain of 32.6 per cent., shown by calculating the lines through the armature in the two cases, though the real gain is not, of course, so great on account of the cumulative effect of increase of lines increasing the E. M. F., which in turn increases the ampère turns.

The leakage in the Edison machine was between the poles and bed-plate, which is filled in with zinc. Removing the cause by substituting a wooden base gave an increase of 6.25 per cent. This is, of course, a capacity increase, not an efficiency one, and shows that a saving can be made in the material used in building, and that the requisite field can be obtained with a smaller expenditure of electrical energy.

A Farewell Dinner to Mr. H. McL. Harding.

In order that the work of the Sprague Electric Railway and Motor Company in connection with the supply of apparatus for the great mining industries of the far West may be properly developed and carried out, the officers of that company have deemed it desirable to place in Chicago their well-known representative, Mr. H. McL. Harding, whose record at the home office has been one of unbroken and splendid success. During his residence in this city Mr. Harding has made many warm friends, and a farewell dinner was therefore arranged by them in his honor. This dinner was given at the Hoffman House last Tuesday, Oct. 1, and was tendered in the names of E. H. Johnson, A. S. Beves, F. J. Sprague, J. H. Vail, C. A. Benton, G. W. La Rue, E. E. Higgins, H. F. Parshall, E. V. Cavell, A. H. Chadbourne, W. H. Temple, J. S. Wise, A. T. Starkey, E. Whitestone. Theo. Beran, S. Z. Mitchell, O. T. Crosby, T. C. Martin, C. W. Dever, C. W. Price, S. D. Greene, C. W. Jenks, S. S. Wheeler, W. W. Monroe, H. W. Blake.

All these gentlemen, with but one or two exceptions, were present when the toscin sounded at 8 P. M., and the party made their way to the Oriental suite of rooms, where a choice dinner was served. At one end of the board sat Mr. E. H. Johnson, President of the Sprague Company, and at the other Mr. F. J. Sprague, who had on his right the guest of the evening.

As soon as the coffee and cigars had been reached, Mr. E. H. Johnson gave the toast "Our Guest," and made a brief, earnest and hearty speech as to the esteem in which Mr. Harding was entertained by all present. He described him as one of the most successful men "in securing a contract" that he had ever known, and pointed to the tremendous growth of the Sprague business as one of the evidences of Mr. Harding's ability. Mr. Frank J. Sprague—the stenographers having been mercifully excused—spoke to the toast of "The Electric Motor," once weak and struggling, but now in all the vigor of youth and with a grand future before it. Mr. Harding then responded very happily to the sentiment of "The Great West," and took occasion to tell how the motor industry had received some of its earliest impulses at his hands in "The Little East," in the country village of Boston. He described the circumstances under which he first saw the Sprague motor and formed his connection with the company, and he now looked forward to the development of another and even greater branch of its business. He regretted to leave so many good friends and close associates behind him, and seized the occasion to express his gratitude for the manner in which the electrical press had assisted him at all times in his work. Mr. E. V. Cavell then broke into poetry over "Our Absent Wives," and Mr. T. C. Martin touched with journalistic modesty on the toast "Ourselves," while Mr. W. H. Temple responded for "The Press." Mr. O. T. Crosby, who has left the Sprague ranks to develop the Weems four miles a minute electric railway, spoke for "Rapid Transit," and Mr. S. Z. Mitchell praised "The Great Northwest," inviting his hearers to spend their vacations under his guidance in Alaska. Mr. E. H. Johnson then gave some exceedingly interesting reminiscences as to his own connection with Mr. Sprague and the motor industry, and cited some striking figures as to the manner in which the business employed labor and invited capital. With regard to the mining work of the Sprague Company, he said that while they were loth to spare Mr. Harding, they felt he was the right man to put in so new and so promising a field that demanded the highest talent for its cultivation, on the principle of "the best reaper for the fattest harvest." Mr. J. H. Vail then spoke in response to "Central Station Engineering," and drew upon the stores of his unequaled experience, in a very striking and suggestive manner. The toast of "The City of New York" was taken up by Dr. Schuyler Wheeler, of the Subway Board, who touched upon the topics of arc motors and small motors, and the idea that no work should be done that was not good work. Mr. Sprague was next called upon, and, after his admirable response, Mr. A. H. Chadbourne showed that Philadelphia had not spoiled him oratorically or blunted the edge of the energy with which in the early days he had advocated the Sprague motor in New England and New York under Mr. Harding's direction. Altogether the speeches were of a most interesting nature, and it is seldom that one sees together so many who may call themselves pioneers in a great department of electrical and industrial work. The banquet terminated about 1 A. M., when Mr. Harding was bidden farewell by all, with innumerable good wishes for his welfare and prosperity under new conditions and amid new surroundings.

Notes of the Detroit Exposition.

The Detroit International Fair and Exposition, which has just closed such a successful ten day's season, is another striking example of what can be done by business enterprise and ability in an incredibly short time. Hardly six months ago the idea of a permanent exposition was broached, and on the 17th of September as perfectly equipped an exposition as this country has ever seen was opened and ready to receive its guests. In the ten days of the Fair over 350,000 visitors passed the turnstiles.

It is not intended to deal in this notice with anything but the electrical features of the Exposition, which is a fair sample of the character of the whole show. Less than 30 days before the opening day the contract for lighting was let to the Brush Company, of Detroit, yet in that time the able and efficient manager, Mr. J. E. Lockwood, had everything in readiness, and lights were turned on, the hour of opening. The electric plant is operated from one Rice engine, 12 × 20 inches; one Ball engine, 13 × 12 inches, and one Russell engine, 13 × 20 inches; this being entirely separate from the power furnished exhibitors, running shafting, machinery and the like. The dynamos are connected to the belt wheels by the Shieren perforated electric belts, furnished by the Detroit house of J. T. Wing & Co. Four 65 arc light Brush dynamos furnish the arc lighting, and one 300 and one 450 incandescent light compound wound Brush dynamos furnish the incandescent lighting and the power for motors, of which there is an aggregate of 20 h. p. used by exhibitors. All the circuits are operated from one switchboard, which is equipped with six of the Lockwood ammeter and polarity indicators. The wiring for the buildings will give an idea of the extent of space lighted, as over three tons of copper are used in the buildings and on the grounds.

The main structure, 500 × 300 feet, is one of most perfectly lighted buildings of the kind. One hundred and fifty arc lights are hung in the aisles, 32 feet apart, while among the decorations of flags, banners and bunting are placed incandescent lamps, so arranged as to heighten the effect of the varied colors. This part of the work has been most artistically accomplished, and is a great credit to its clever designer, Mr. Lockwood. All the exhibitors have resorted to the now indispensable electric light, and with incandescent lamps of every color and hue in all the booths, the effect is beautiful.

In the lighting of the Exposition grounds, over 60 acres in extent, a new departure is seen. The main building has a tower 150 feet high on each corner, and over the main entrance another 200 feet high. On each of these are placed eight arc lamps of 2,000 c. p. each, and being on each corner of the building the light is thrown in the most economical way to every nook and corner of the vast grounds; and the light is so thoroughly diffused that one can see to pick up a coin in any part of the grounds.

Standing apart from the main building is the art gallery, and this is lighted by 250 sixteen-candle power incandescent lights, of the Swan 110-volt pattern. Mr. Schumann, the art dealer and connoisseur of New York, the owner of Makoffsky's "Russian Wedding Feast," which, by the way, has attracted more praise, admiration and wonder than any other exhibit, says that the lighting of the art gallery is the most perfect in his long experience in America and abroad. In a letter to the Brush Company he says: "The light of your incandescent lamps was steady, powerful and white, and showed the painting to better advantage than I ever saw it before." Mr. Schumann has just come from the Buffalo Fair, and has exhibited his celebrated painting both in this country and Europe.

An interesting exhibit is that of the United States Fish Commission, in the north end of the main building. About twenty separate aquariums, containing some of the choicest varieties of the Commission's clientage, have been arranged in rockwork, moss and the like, lighted from the rear by incandescent lights, which diffuse their soft rays through the water.

Many other exhibits depend largely for effect upon novel ways of arranging the lights. But the great lesson taught by this show is that the electric light is the light of to-day and of the future. No other can bear comparison, can afford the varied application, can furnish the artistic effect. Its presence in office, store or city marks the presence of the spirit of the age; of business enterprise and success, of modern science and modern thought. The most forceful indication of the greatness of the American people is the readiness with which they reach out and grapple with the forces of nature, chain them and harness them, subdue them to the uses of commerce, industry and the needs of daily life.

C. P. L.

Detroit, Sept. 28, 1889.

An Electric Boat on the Housatonic.

On Sept. 30, a trip was made on the Housatonic in Mr. Gower's new electric boat, this being the first craft run by electricity to navigate the waters of the Housatonic. It is an ordinary sized rowboat 14 feet in length and 4 feet wide. A structure in the centre contains the storage battery, of 50 cells, which furnishes the power for the motor. The electricity for the batteries is taken from the Star Pin Company's dynamo, conducted by wires from the factory to the boat and requires eight hours to charge them.

The boat is equipped with a Perret motor, built by the Elektron Manufacturing Company, of Brooklyn, and it does its work in the most satisfactory manner. The Perret motor, which is used, is a light one, weighing but 90 pounds, but is of 1 h., p., and wound for a pressure of 100 volts. It can be reversed quickly and stopped instantly. It is built so that in starting the power is applied gradually to the motor, thus obviating the danger of burning out the armature. The whole equipment has proved a great success, and Mr. Gower has good reason to be satisfied with his boat.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-177 TIMES BUILDING, NEW YORK, Oct. 7, 1889.

Mr. H. L. Shippy, secretary and general manager of John A. Roebling's Sons Company, sailed for Italy on Saturday, Sept. 21, where he will join his family.

Electric Banjos.—I had the pleasure a few days ago of hearing the electric banjo at H. Fenton's, 59 Maiden lane, while calling on the P. & B. Paint Company. It is very ingenious.

Aries P. Brooke, 86 Fulton street, N. Y., manufacturer of glass molds, especially guarantees his molds to work in any factory. Mr. Brooke has gained a wide reputation for the excellence of his work. Models and designs are given particular attention.

Mr. M. Mayer, a rising young electrician, graduate of Stevens, formerly connected with the C. & C. Electric Motor Company, and later with the Continental Dynamo Company, is now, and has been for some time past, with the new Century Electric Company of this city.

Mr. W. H. Eckert, general manager of the Metropolitan Telephone Company, has now, also absorbed the position of general superintendent of exchanges, formerly under the management of Mr. W. A. Vail, who is now at the head of the steam-heating business in Boston.

Mr. W. D. McQuesten, the well-known consulting electrical engineer, has removed his offices from 2 West Fourteenth street to 15 Cortlandt street, where he will continue his practice, already so large, in the development of electric railway enterprises, equipment of central lighting stations, wiring of new buildings, installation of isolated plants, etc.

The Brooklyn Electric Light and Power Company, who were granted an extensive franchise a week ago, have had it rescinded and granted for the Eastern District only, the price of lights being stipulated. The company has had great trouble for some time past in getting permits to erect poles and carry on their business in good shape. They have made a large addition to their plant.

Mr. A. L. Bogart, 22 Union Square, met with a severe accident while out riding a short time since, when near home. Mr. Bogart has a fine span of horses, and generally meets his wife on return from business in the evening, and takes a spin down the fine macadamized roads of Long Island, his home being at Jamaica, L. I. When nearly home the horses became frightened and threw him against a tree, cutting and bruising him so badly that it was thought he was killed. By a miracle Mrs. Bogart was practically unhurt. I met Mr. Bogart the past week and he looks himself again.

Mr. Alfred A. McCreary, maker of reflector shades, 18-20 Cortlandt street, New York, has just completed a very creditable catalogue of his specialties. His silvered shades are shown in practical operation, and the new incandescent revolvable lamp shade is meeting with big success among all who become acquainted with its many advantages. They are made in colors for decorative purposes. He has lately brought out a new and valuable shield for arc lamps to keep out rain, sleet and snow, also a new guard and reflector for factory use. The whole catalogue is very neat, and should be in the hands of all electric light construction companies and other users of this class of goods.

Mr. Owen Walsh, 105 Walker street, New York, manufacturer of speaking tubes, alarm whistles, bell-wire tubing and electrical supplies, has lately put upon the market a new carbon battery, with which he expects to do a large business in connection with his trade in supplies. Mr. Walsh is also supplying large quantities of zinc tubing for all electrical purposes, and has converted the ordinary old-time putty-blowers we used in boyhood days into wire tubing by making one end small enough to enter the end of each following tube, thus enabling the wire to be run through them. They are made in sections 20 inches long and ¼ inch diameter, and are just the article for electrical wiring.

The Clark Electric Company have recently brought out a number of very fine cuts, illustrating their complete system of arc lighting. A few sets of these engravings have been handsomely mounted and framed for special purposes. One of them was presented to the patent department of The W. J. Johnston Company, Limited, and adorns the walls of the manager's office. This company are now installing arc lighting plants which in every instance are giving great satisfaction. They do business on the principle that "the best is the cheapest," and they claim that theirs is the most economical arc system in the United States. They are always glad to see friends at their new offices in the Corbin Building, 19 Broadway, this city.

The Kings County Electrical Company is the name of the new company under the management of Mr. C. H. Carter, formerly electrician and superintendent of the United States Electrical Company. The salesrooms and office of the new company are at 330 Navy street, Brooklyn, N. Y., where they manufacture and deal in all kinds of electrical apparatus, batteries, motors, dynamos, etc. Special attention is given to electric gas lighting, medical apparatus and burglar alarm work. They have just brought out a new arc lamp for interior and exterior lighting, and suitable for running either on high or low tension circuits. The one I saw was running in series with a Thomson-Houston arc lamp; the carbons are, it is claimed, controlled solely by the current. For low tension or incandescent circuits there is a large field for a lamp of this description.

The New Century Electric Dynamo Company., 21-25 Bethune street, New York, are very busy building dynamos for electro plating. The demand is constantly increasing, and wherever the machines are in use they are spoken of in the highest terms. Especial attention has often been called by the users of these machines to the fact that wires of the external circuit have often become crossed through carelessness, as in the work of plating bare wires are used; but, although thus short circuited, the machine has never been affected in the least, while other machines have been known to burn out their armatures. Similar tests of the machines have been taken by the electrician of the company without injury to the armatures. These machines are built from fifty watts up. The New Century Company are also bringing out an entirely new type of motor, in sizes of ⅛ h. p. up. They have the greatest confidence in this new motor, and will push it to its fullest extent.

The New Haven Clock Company have installed 225 numbers of the Porter electric messenger and annunciator system at Lake Hopatcong. The system has been working very satisfactorily for nearly two years in a large hotel in Duluth, Minn.; at Lakewood, N. Y.; and at the springs at Kansas City, where over 200 numbers each are installed. In the Auditorium Hotel, Chicago, 365 rooms are being fitted up; they call for Okonite wire amounting to nearly $2,000. Their fire-alarm and guest-call system are also being installed there, and they have also several large contracts which are just being closed. They are busy to their full capacity in telegraph keys and sounders. The combination sounder, of which they make a specialty, is still in great demand. The Crowdus battery, for which they are Eastern agents, is also having a big sale. One of the largest telegraph companies reports 20 per cent. greater efficiency from the Microphone battery than any other cell. They report large sales of common drop annunciators, and are just completing the equipment of the Hotel Lincoln, New York, with 250 numbers, also with their watchman's clock system.

The E. S. Greeley & Co.—The old and noted house of E. S. Greeley & Co., 5 and 7 Dey street, have been meeting with unparalleled success for the past few years in telegraph, telephone, electric light and railway supplies. So great has been the demand upon them and their many additional specialties they were compelled to increase their space in the sales and store department, and have added 600 feet of shelving. Mr. M. W. Goodyear, general manager of the electrical department, has moved his office to more commodious quarters in the rear of the store, and is contiguous to Mr. E. S. Riggs, the assistant treasurer. Gen. E. S. Greeley, the president, has been remodeling his room, which is now made more comfortable. Mr. T. J. Smith, Assistant General Manager, retains his office in the front part of the store, where he is conveniently situated to meet all inquiries. Many new electrical specialties have been added to the already large stock. Their Troy test instruments, Wheatstone bridges, combination galvanometer and resistance sets, photometers, etc., are meeting with excellent success, particularly the combination sets. F. A. Magee, the outside manager, is kept actively engaged attending to the sales of this department. I. M. Post, of the electrical supply department, may always be found busy with orders, together with his assistants, L. J. Weaver and H. P. Krauz. Mr. J. W. Sands is the secretary, and also looks after the cash accounts. H. L. Bruns, the book-keeper, handles the accounts, and A. Timmermann assists him. P. Schaffer, C. C. Wilson, J. L. Woods and R. A. Morrison run respectively shipping, receiving and collecting departments, and S. E. Estes, asbestos department.

The Harlem Opera House on West 125th street was opened on September 30, with the play of "The Wife." This beautiful building has been erected and equipped by Mr. Oscar Hammerstein at a total cost of not less than $525,000. It is massively constructed, the decorations are rich and tasteful, and of course the electric light is employed. All the electrical work has been done under the able direction of Mr. Fremont Wilson, the electrical engineer, assisted by Mr. C. G. Young, of the Mt. Morris Electric Light Company. The theatre has its own dynamo room, etc., but extensive building is still in contemplation, requiring a big plant, and in the meantime current is obtained from the Mt. Morris station near by, on Eighth avenue, from a Westinghouse alternating plant, the dynamos of which are driven by a Fitchburg engine with Munson belting. The Westinghouse apparatus was installed with wonderful rapidity, in order to meet the exigencies of the case, involving a remodeling of the station inside of 12 days, but the work has nevertheless been satisfactorily done. From the station the circuits are carried underground through the Johnstone iron conduits to the theatre, to a bank of no fewer than 28 Westinghouse converters, and thence to an ingenious switchboard in the wings, from which point Mr. Wilson is able to ring the changes on a number of beautiful effects throughout the house. The lighting is very soft, pleasing and well distributed, and Mr. Wilson has been very successful, not only in the rose-colored lights along the dome of the proscenium, but in the balcony front, where the lights are masked behind globes the shape, size and color of natural roses There are also a number of tasteful special designs in the fixtures, which were furnished by the Archer & Pancoast Manufacturing Company. Altogether, Mr. Wilson is to be warmly congratulated upon a fine piece of work. I understand that he is now busy on plans for the extensions spoken of above.

Mr. Charles E. Perring, whose name is associated with some of the famous industrial art work of this country, and whose designs in art chandeliers are to be seen in the most noted places of amusement, public and private buildings, etc., has been connected for some time with the well-known electric and gas fixture house of Oxley, Giddings & Enos. Some of his latest work in designing and drawing are the electric and gas combination chandeliers and fixtures for the Tremont Theatre in Boston. The auditorium is fitted with an 80-light chandelier of Italian gold, about 14 to 16 ft. in diameter, a series of imitation sea-shells wrought from burnished copper forming reflectors for the lamps, being a part of each branch, and over the lamps. The branches extend out in beautiful curves from the central body of the fixture. The main body is 48 inches in diameter and all formed of filagree work, and is said to be the largest piece of spun work done in this country. The main vestibule combination chandelier contains eight incandescents and eight gas jets, the latter concealed in floral work, the former being brought out in bold relief. It is made altogether of wrought iron, having a spread of five feet from lamp to lamp, is about 12 feet high, and is designed after fifteenth century German work. Three 6-light and one 12-light combination chandeliers with the gas jets concealed from immediate view, the electric lamps being boldly brought out, all made after the style of the Renaissance, and wrought by hand from sheet metal, carrying leaves and shells in Italian gold and oxidized silver relief, and burnished copper on the interior of the shells behind the lamps acting as reflectors, will illuminate the foyer or lobby of the theatre. Under the balcony will be suspended six fixtures of very novel design, consisting of large bowls of twisted opalescent glass artistically draped at the top with filigree chain work, and mounted with beautiful filagree crowns; inside the opalescent bowls are located four incandescent lamps, and springing from the centre of the fixtures out of and over these bowls are five lamps over which spread palm-leaf reflectors wrought of burnished copper; above these the gas jets are displayed in silver calla lilies. In the smoking-room is a handsome wrought copper chandelier, the central body of which forms an antique vase of opalescent glass enriched with a guard of fine filagree work. Six lamps are inside the vase, and six unique branches are suspended on the outside, from each of which are hung cornucopias of opalescent glass, each containing an incandescent lamp. The upper portion is worked into neat and fanciful shapes of wrought copper.

Oxley, Giddings & Enos are also fitting up the First Presbyterian Church of Newark, N. J., with an elaborate central chandelier containing 75 incandescents, the whole idea being taken from the bursting of a rocket, which is carried out in burnished brass. The new wing of the Mutual Life Insurance Company's handsome building in this city is being fitted up. The officers' rooms will contain the most elaborate electroliers that have ever been placed in any business building in this country. They have numerous other public buildings that they are preparing special designs for. I was delighted also with the designs shown me by Mr. Perring, one of which he made for Tony Faust, of St. Louis, the noted restaurateur. The central body was a large sphere of dead copper with four smaller spheres surrounding it; from these spring seaserpents' heads, their forked tongues carrying the electric lights. The spheres are covered with starfish, scallops and other shell-fish, which were cast from the natural shells themselves, and are finished in oxidized silver. Draped from ball to ball is a heavy chain finished in iron, from which is suspended under each ball an anchor; the gas globes—this being a combination fixture—are fitted in a quaint holder representing a wicker basket, such as oysters are carried in. The canopy is crowned with fine plaited work, representing a fish net. From just below the canopy the whole fixture is apparently suspended by four natural hemp ropes, tied and knotted together in sailor's double knots. Mr. Perring designed all the fixtures now in the Union Square Theatre and Morton House, and other prominent buildings. All the fixtures in the Dakota flats were designed by him, this order amounting to $ 130,000, the largest ever given, it is said.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.
BOSTON, Oct. 5th, 1889.

Cambridge, Mass.—The new public library is to be lit by 100 incandescent lights.

Nantucket, Mass.—The Nantucket Electric Light Company is about to increase its capacity.

Adams, Mass.—The street cars in this city will probably be running by electricity this week.

Mr. C. D. Doubleday, Manager of the New York branch office of the Marr Construction Company, was in the city this week.

Frank Ridlon & Co. have sold a 200-light Fuller Wood arc light dynamo to E. S. Hamlin & Co, of Boston. The Wright Electrical Engineering Company will do the work of installation.

North Andover, Mass.—The Davis & Furber Machine Company are putting in an additional 600-light dynamo, and they are considering the advisability of using the electric light throughout.

Newton, Mass.—The Newton Street Railway Company has deposited bonds with the Board of Aldermen, as a guarantee for carrying out its terms of contract with the city in building an electric railway on Washington street.

Rockport, Mass.—In a few weeks the French cable will be landed at Rockport, instead of at North Eastman as formerly. New instruments will be put into the Commercial Cable Company's office at Cape Hedge, where the cable will be connected.

Salem, Mass.—The Naumkeag Street Railroad Company has recently been granted permission by the Railroad Commissioners to increase its capital stock $200,000, and a similar amount on its bonds. In all probability this sum will be used in putting in an electric plant.

Locations for Poles in Boston.—At a regular meeting of the Board of Aldermen it was ordered that hereafter all orders granting locations for poles for electric wires, shall state the width of the sidewalk, the diameter of every pole at the sidewalk, and the height of the pole.

Lowell, Mass.—The Lowell Horse Railroad Company and the Lowell & Dracut Horse Railroad Company have petitioned the Board of Aldermen for permission to use electricity as a motive power on all their cars running in the city. They will be given a hearing on October 22.

Lynn, Mass.—At a meeting of the Lynn Board of Aldermen, held this week, a hearing was given the Lynn & Boston Railroad Company, on their petition for rights to lay tracks in this city and operate cars by electricity. There was no opposition and the hearing was declared closed.

Peabody, Mass.—The Westinghouse Electric Company secured a hearing from the Selectmen this week to consider their petition for permission to locate in this city. The petition was strongly opposed by the Salem Electric Lighting Company. Decision has been reserved.

Cambridge, Mass.—The Cambridge Electric Light Company has petitioned the city government for permission to substitute new poles in North avenue, Main and Harvard streets, the new ones to be set in cement and used in conjunction with the West End Street Railway Company of Boston.

E. S. Ritchie & Sons, Brookline, Mass., have recently received an order amounting to about $5,000 for the supply of ten binnacles to be used on board the new cruisers. Messrs. Ritchie & Sons are extensive manufacturers of all kinds of electrical testing instruments and general electrical apparatus.

H. E. Swift & Co., since moving down to their new quarters at 62 Sudberry street, have been besieged with work, and have already had to double their premises. They are at present extremely busy in large orders for K. W. cut-outs, fuse boxes, switches and various kinds of electric light attachments.

Underground Electric Wires for Boston.—The Fire Commissioners presented to the Board of Aldermen, at a regular meeting of the Board, held this week, a communication calling attention to the resolutions adopted by the National Association of Fire Engineers, advocating a uniform system of placing electric wires underground.

Insurance.—The representatives of the electric light companies of Boston, and the committee of the Boston Board of Fire Underwriters, spent some time this week in discussing the matter of fire risks in buildings wired for electric lighting. Nothing new has been arranged, and the Board of Fire Underwriters will make a written proposition to the electric light companies.

Waltham, Mass.—This city is on the lookout for electrical apparatus. A few of the aldermen recently visited the town of Plymouth for the purpose of inspecting the electric road. Boston also received a visit from these gentlemen, who spent part of their time in inspecting the police signal systems, the Municipal Signal Company and the Gamewell Fire Alarm Company.

Mr. Chas. E. Bibber, representing the Holtzer-Cabot Electric Company, of Boston, has started out on a protracted tour to the Pacific slope. Starting with New York, Mr. Bibber will work his way out West via the St. Louis Exposition to San Francisco, Denver, Salt Lake City, Portland, and all other important Western cities. The trip will probably take about three months.

Paine & Francis, agents for the Edison Company, report the following sales in New England: Pembroke Mills, Suncook, N. H., 360-light plant; Bangs Brothers, Augusta, Me., 45-light plant; Pettee Machine Company, Newton Upper Falls, Mass., 275-light plant; Marlboro Electric Light Company, Marlboro, Mass., increase of two 500-light dynamos and fittings; George H. Eaton & Co., Boston, 90-light plant.

Wakefield, Mass.—The Wakefield Electric Light and Power Company and the People's Electric Light and Power Company were both given a hearing this week by the Selectmen for permission to locate their poles. Mr. A. P. Wright, of Boston, stated that the town could be well lighted with 60 or 70 arc and 600 or 700 incandescent lights, and that the probable cost would be about

$30,000. The Selectmen will consider the rival petitions and will probably make a decision next week.

The Marr Construction Company, of Boston, are at present engaged in installing the following plants, using the Westinghouse direct current machines: Overmann Wheel Company, Chicopee Falls, Mass., 300-light plant; Old Town Woolen Company, Old Town, Me., 300-light plant: Hartford Woolen Mills, Hartford, Vt., 300-light plant; Boston Tug Boat Company, Boston, 50-light plant; A. H. Morrison Brothers, Braintree, Mass., 300-light plant. Besides these isolated plants they have just commenced a central station for incandescent lamps at Canton, Mass.

Music from Afar.—An interesting test of the phonograph over the wires of the Long-Distance Telephone Company was made in the office of the Long Distance Telephone Company, in this city, one day this week. An Edison phonograph attached to a telephone in a Philadelphia office was the source of the music, and by putting on one's head a special arrangement of wires, with enunciator attached, we could hear coming over the wires with extreme distinctness such soul-stirring melodies as "Johnnie, get your gun," "Yankee Doodle," and the "Star-Spangled Banner."

Beverly, Mass.—A trial trip of the storage-battery car, fitted out by the Union Electric Car Company of Boston, was made last week to the entire satisfaction of all concerned, a speed of 15 miles an hour being easily attained. Mr. Stevens, the inventor of the system, was present and personally conducted the trip. One of the chief features of the car is the system of gearing, which is enclosed in a dust-proof box filled with oil. With this system also, brakes are entirely unnecessary, as the energy required to retard the car, or stop it, is furnished by the motor itself, which, for the time being, becomes a dynamo engaged in re-charging the accumulators. By this method the Union Car Company hope to make a large saving in the power consumed, as well as to reduce the friction by means of their special gearing.

Minor Notes.—The Braintree Electric Company, the Mansfield Electric Company and the Foxboro Electric Company have been chartered, each with a capital of $10,000, Wilbur A. Stiles being president and Henry N. Bates treasurer of each. The transfer of the Amherst electric light plant has been made to the Amherst Gas Company. The Exeter, N. H., Board of Trade has invited the Thomson-Houston Company to put in a plant. The Concord, N. H., Gas and Electric Light Company has bought land for its station. Mr. J. Kimball is president and Mr. E. H. Woodman, treasurer. The arc plant at Laconia, N. H., is to be removed to Lake Village. The New Bedford Gas Company is going in heavily for arc and incandescent lighting, and the New Bedford Edison Company is increasing its capital stock to $150,000. The Warren, R. I., Electric Light Company has elected Mr. J. Waterman president, and Mr. B. W. Bosworth secretary and treasurer.

Thomson-Houston Electric Company.—As illustrative of the wonderful growth of the Thomson-Houston electric light system, the following tabulation will be perused with interest:

ARC LIGHT PLANT.

	Companies.	Lights.
October, 1883	22	1,65
January, 1884	44	3,98
January, 1885	82	8,96
January, 1886	106	13,22
January, 1887	171	21,84
January, 1888	358	44,41
July, 1889	478	58.73

INCANDESCENT LIGHT.

January, 1887	29	11,27
January, 1888	78	48,23
January, 1889	90	66,13

ALTERNATING CURRENT INCANDESCENT LIGHT.

January, 1888	23	11,10
January, 1889	80	54,25

It is estimated that the capital now employed in these various local companies is between $15,000,000 and $20,000,000.

Mr. George Westinghouse, Jr., was in the city this week, and in an interview with a representative of the Boston *Advertiser* made the following statement: "Our latest venture is the formation of the Overhead Conductor Electric Railway Company, of Pittsburgh, Pa., an organization the stock of which is controlled by the managers of the Westinghouse Electric Company. It was intended in the first instance, as a part of the business of this company, to license manufacturers, but the necessity for the use of late inventions controlled by the Westinghouse Electric Company has so changed the conditions that the Westinghouse Electric Company has decided to actively push this important industry with the same energy that has characterized its work in electric lighting. Though it is admitted that the overhead conductor system and the generating apparatus is satisfactory, yet there is not an unbiased engineer who has studied the problem who hesitates to say that the present form of apparatus now in use on cars is still susceptible of improvement. The worst defect in the existing method is the necessity for stopping and starting the motor each time the car is started. When an electric motor is started its efficiency is at the zero point and the consumption of electricity is excessive, often resulting in the destruction of an "armature" or "field." Every person has noticed the terrific effort horses have to make in starting a loaded car, which is afterward moved along so easily. In like manner the electric motor has to exert its greatest force in starting a car, and, like its predecessor, is often seriously injured in its effort. To obviate this greatest difficulty has led to the use of large motors, being in effect the same as if two teams were put to each car. The horses would not be injured by the strain, but they would eat twice as much, and consequently increase the cost of operating. The use of large motors that are stopped and started with the car, and the consequent low average electrical efficiency, necessitates large electric generating apparatus with correspondingly large engines and boilers. Not only does the present system require this larger capacity of electric generating apparatus, but it requires a greater and more dangerous current to be carried overhead. It is estimated that less than 20 per cent. of the power is expended by the engines doing effective work when cars are stopped and started frequently, though when a motor is just the size required, and is run at its right speed, an efficiency of 80 per cent. is possible. To avoid loss of power demands the use of a motor constantly run at its critical speed, or that speed at which the highest electric efficiency is obtained; with a motor in constant motion, the momentum of the armature becomes a positive advantage, unlike its inertia, which is a serious disadvantage when started from rest. If the motor runs at a constant speed, then there is required only a suitable device to be interposed between the motor and car axle, whereby any rate of rotation of the car axle can be had at the will of the attendant. The Westinghouse Electric Company has perfected one form of device having the customary gears, whereby the above described feature is accomplished in a simple and effective manner, thus enabling the use of properly proportioned motors of moderate capacity, requiring less than half of the electricity heretofore thought necessary. A second form, that will dispense with the objectionable gearing, and that will permit of a wide variation of the relative speeds of the motor and car axle, is approaching completion, and when all of the details are properly proportioned will be the ideal device." A. C. S.

WESTERN NOTES.

Branch Office of The Electrical World,
39 Mallers Building, Chicago, Oct. 5, 1889.

Mr. F. S. Terry, of the Electrical Supply Company, Chicago, goes east this week on a business trip.

Ernest L. Clark, 80 Adams street, Chicago, is about to open up an extensive pole yard in Chicago.

Mr. William Oswald, of New Orleans, is reported to have sold eight isolated Edison plants within the last two weeks.

Thomas Byrnes, of Evansville, late Democratic candidate for state treasurer of Indiana, is reported by the daily press to have devised an electric meter for incandescent circuits.

Carl Kaummeyer, of Eau Claire, Wis., visited friends in Chicago en route home from a special trip on legal business, during which he captured an order for an incandescent plant.

The Milwaukee, Wis., "Journal," of September 7th and 28th, contains a verbatim report of the spicy debate before the city council regarding the proposed electric light ordinance.

Mr. George H. Bliss returned to Chicago this week from an extended Eastern trip taken in the interests of a manufacturing concern, who are about to form important business connections.

Mr. Fred W. Best, of Kiefer & Best, Denver, Colo., called on his many friends in Chicago while en route West from New York, where he selected a handsome line of electroliers for the fall trade.

S Rosenstamm, with Lewisohn Bros., New York, is sending a perpetual calendar of exquisite design engraved on celluloid and worthy of a place in a lady's boudoir, to his many friends in the west.

V. H. Yarnell, of the Daft Electric Light Company, New York, visited various points of interest to electricians while stopping in Chicago, en route to Superior, Wis., where the Daft railway system is being installed.

Mr. F. W. Horne, of Chicago, formerly Western manager of the Excelsior Electric Company, is now asssociated with the railway department of the Thomson-Houston Electric Company, with headquarters in their Chicago office.

Mr. W. H. McKinlock, of the Central Electric Company, Chicago, has returned from an extended pleasure trip through the mountain regions of Colorado. Mr. McKinlock was accompanied by his family, and all had a most enjoyable time.

The Knapp Electrical Works, Chicago, have been unable to keep up with the demand for their disque Leclanche batteries, and are now some 1,750 cells behind their orders, which, Mr. Knapp says, is due to the excellence of the porous cup used.

Chief Stetson, of the Minneapolis fire department, will place four miles of 10-wire cable, 3,000 feet of 15-wire cable, and a total of several miles of 10 wires and smaller cables underground this fall, all to be of the Standard Underground Cable Company's manufacture.

The Rau Patent Oil Can Company, Chicago, have supplied their oil cans to the electric stations at Houghton, Mich.; East Cleveland, St. John, N. B., etc. Their orders are now coming in so fast that increased facilities are required, and the company will shortly move into larger quarters.

The Darche Electric Company, Chicago, report as a result of one insertion of their card in The Electrical World the receipt of orders and letters of inquiry from residents in almost every State and Territory in the Union regarding their electric alarm clock. Railway employés are especially good customers.

President Mills, of Earlham College, Richmond, at the Indiana annual meeting of Orthodox Friends, held at Richmond, Ind., Sept. 30, spoke on the rising importance of the science of electrical engineering and of the immediate necessity of equipping their laboratory with the necessary electrical apparatus.

Mr. C. C. Perry, of the Jenney Electric Company, Indianapolis, was entertained at the Electric Club rooms recently. Mr Perry will not follow the fortunes of the Jenney Company to Fort Wayne, but remain in Indianapolis, and manage his central station plant, which will soon be supplying current to several thousand lights.

The Archer Electric Manufacturing Company, Wichita, Kan., brought suit in the District Court at Lyons, Kan., Sept. 24, against the Sterling, Kan., Electric Light and Power Company to obtain the price of an electric light plant there installed. The evidence showed that the Archer Company had not done as agreed and had improperly installed the plant, so the case was thrown out by the court. The Archer Company took an appeal.

Electric Railways.—An electric street railway system will shortly connect the towns of Ispheming and Negaunee, Mich., a distance of some three miles. There is every prospect of having an electric railway constructed between St. Paul and Minneapolis. The plans are now being drawn and estimates prepared. The Laredo, Tex., electric street railway system is completed and will be in full operation this next week. The Ivanhoe Park Electric Railway Company, Kansas City, has completed its line, and is only waiting for the arrival of the cars to commence transporting passengers. The Thomson-Houston system is employed.

Bids for Furnishing Electric Light Apparatus.—The following bids were made for furnishing electric light apparatus to the city of Chicago, opened on Friday, Sept. 20: Thomson Houston Company, 50-light dynamo, lamps, etc., $3,645; Fort Wayne Electric Light Company, 40-light dynamo, lamps, etc., $3,040; Excelsior Electric Company, 30-light dynamo, lamps, etc., $1,935; Brush Electric Light Company, 30-light dynamo, lamps, etc., $1,825; Jenney Electric Company, Indianapolis, Ind., 35-light dynamo, lamps, etc., $2,248.75; Western Electric Company, 30-light dynamo, lamps, etc., $1,950. All the lamps were of 2,000 c. p., and allowance was made in the bids for various additional apparatus.

The Fort Wayne Company's Shops.—Chester C. Buck, of Plymouth, Ind., brought suit, Sept. 26, in the Superior Court against the Fort Wayne Jenney Electric Light Company for $50,000 damages for breach of contract. The complaint alleged that the Jenney Company agreed to move their arc department to Plymouth in consideration of plaintiff supplying $110,000 in stock, $50,000 of which was to be used in the purchase of property and erection of buildings. Large shops were completed, and before the remainder of the money was paid the company were asked to show by an invoice that the stock was worth the price quoted. This request was refused for reasons the company considered sufficient, which led to other complications, resulting in the Jenney people refusing to carry out the agreement. A representative of the Fort Wayne Jenney Electric Light Company states that he understood that the Plymouth people were to erect a factory worth at least $50,000, while the total value of the building they did erect, including cost of grounds, will not exceed $15,000.

The Electrical Supply Company, Chicago, in their new catalogue, No. 500, have incorporated a series of tables and reliable data of great value to every one interested in the science of electricity, and especially to parties installing electric light or power plants. There are tables showing the weight and the resistance of german silver wire, the equivalents in sizes of copper wire; H. Ward Leonard's paper on the size of conductors for the distribution of electricity, with accompanying tables and diagrams; tables arranged by E. A. Sperry, showing the carrying capacity in ampères and in 16 c. p. lamps of commercial copper wire, and the amount of drop in wires with a given circuit. Then there are wiring tables for lamps designed for currents of various potential, followed by Carl Hering's equivalents of units of measurements, and by Prof. Carhart's article on the size of wire for the distribution of electricity. There are many other tables and valuable data contained in this combined trade catalogue and work of reference that will lead to its being preserved as carefully as was the "book of tables" issued by this enterprising company in 1886.

Mr. Edward Flad, of St. Louis, will test a new device for maintaining a circulation of air in the subways now being laid in that city, regarding which the *Globe-Democrat* says: A St. Louis man has invented an ingenious contrivance which will be tested in a few days, and which the Subway Company believes will absolutely absolve the underground project from danger. It is merely an "electric stove," two zinc walls, the outer one forming a box 18 inches long, 1 foot wide and 8 inches thick; the space of 2 inches between this outer and the inner wall is filled with an insulator; both walls surround a cavity of 4x8 inches, which is open in the bottom, and converges at the top to a 3-inch zinc pipe that can be continued any length up to the surface, where a casting protects it. One of these stoves will be set in each manhole, and alongside it will be a corresponding pipe for cold air to descend. This air will be heated by a coil of German silver wire in the cavity mentioned, which coil will be kept from very hot to a white heat by electricity passing through it from a dynamo which the Subway Company will run for that business. This will keep up a circulation through the subways that will carry off the explosive gases.

The Chicago Electric Club.—The first regular business and literary meeting held by this club since last spring was called for last Monday evening, to enable the members to discuss the programme prepared for the winter season by the entertainment committee and to listen to the reading of a paper by F. B. Badt that proved short but interesting. As only some twenty-five members and guests finally dropped in on Monday evening, it was suggested by Mr. Alex. Kemp, who presided, that in the absence of the majority of the officers and the entertainment committee the meeting be an informal one. But the regular order was finally carried out and the reading of Treasurer Terry's report showed a cash balance on hand of some $250. It has been suggested that the entertainment committee outline a course of readings for the season and furnish each member with a programme, or allow at least two weeks' notice in order that all may have an opportunity to read up on the respective subject and thus be able to discuss it more intelligently. It is further suggested that the non-resident members be invited and encouraged to send in one or two questions covering some point of the subject under discussion that does not appear clear to them. The secretary to read the queries when the discussion of the paper is opened. Among the visitors at the club-room during the week were: President Edwin R. Weeks, Kansas City; Major Geo. B. Shaw, Walter K. Freeman and Carl Kammeyer, Eau Claire, Wisconsin; Geo. Mayo, Rockford, Ill.; Francis B. Crocker, New York; A. E. Frank, Deadwood, Dakota; Beverly Jefferson, Madison, Wis.; Stetson Leach, Denver, Col. F. De L.

Detroit, Mich., Oct. 3, 1889.

The Detroit Electrical Works, Detroit, are placing a handsome line of new pattern bronze pushers on the market; also a compound push of convenient design.

The Standard Electric Company, Detroit, have their factory approaching completion, and expect to be in position to fill orders for the Logan storage battery by the New Year.

The Commercial Electric Company, Detroit, finds their present quarters far too small for their business, and will shortly move into a building specially adapted for the supply line. They report having wired some fifteen buildings for incandescent lights.

The Woodward Electrical Company, Detroit, will shortly place a motor car on exhibition, containing 60 cells of the Detroit storage battery, that is guaranteed to run 150 miles, while drawing a trail car containing from 80 to 100 passengers. The motor car is arranged to carry 12 passengers, and is adapted for a smoking compartment.

Grand Haven, Mich., suffered severely from a terrible fire that destroyed the Western Union Telegraph Company's office, the United States Signal office, the telephone exchange and the residence of Mr. T. A. Parish, manager of the telephone system, besides many other buildings. Much sympathy is expressed for the sufferers by the conflagration.

Captain C. C. Chadwick, manager of the Parrish Bros. & Peck Electrical Company, Detroit, states that General Manager Dickinson, of the Missouri Pacific Railway, is so well pleased with the operation of their signal system that he has had his own private train equipped with it, and takes great pleasure in showing its perfect operation to other railroad officials.

The Woodward Works.—The Detroit *Journal* has a notice regarding the closing of the Woodward Electrical Company, of Detroit, in which Mr. G. H. Gale, the president, says he expects financial matters to be straightened out. The battery is now one of the best in the world. To your correspondent Mr. Gale said that the company would be in practical operation again within thirty days, and that every dollar of indebtedness would be paid at once. Mr. Gale further stated that he owned 23,000 of the 40,000 total shares, the balance of the stock being distributed among eighty-one parties.

Milwaukee, Sept. 30, 1889.

John A. Hinsey states that his electric street railway, the contracts for which have been awarded, will cost about $25,000 per mile of single track. The Thomson-Houston Company, of Chicago and Boston, will furnish the motors and electrical machinery. The company will lay its own tracks.

The Kaukauna Electric Light Company has filed articles of association with the Secretary of State: capital stock, $30,000 incorporators, William H. Earles, Charles Kirchoff, Jr., and Henry Junge. They will begin to put in their plant immediately. They have already secured contracts for about 700 lights.

The Edison Electric Illuminating Company is preparing to embark in business as soon as its franchise is obtained. D. M. Benjamin, Charles Ray and C. F. Ilsley, who signed the articles of incorporation of the company, have called a meeting to be held on the afternoon of Thursday, Oct. 10, for the purpose of completing the organization of the company. By-laws will be adopted and a board of directors elected. When the franchise is passed and signed by the Mayor, the company will be ready for business. A member of the company said yesterday that work on the plant will be commenced this fall if winter does not set in much earlier than is expected. The main business will be to furnish incandescent lights

for business and dwelling houses, but if it is found that there is roo n for another arc plant one will be put in.

Electric Roads.—The delay in passing the electric franchise of the Cream City, Milwaukee City and West Side roads has made it practically impossible for them to build the electric lines this fall even if they get the franchises. A street railroad man said this morning: "There is no chance of any of the roads building this fall. It will be the first of November before the franchises are passed if they are subjected to no unnecessary delay, and it is more than likely that they will be held back much longer. Then there are contracts to make, machinery to build and materials to get, which will take more than one month, and by that time winter will be upon us. It is practically impossible for any actual work to be done on the roads this year. Of course, the preliminaries may be taken care of and the deck cleared for action early next spring."

LOUISVILLE, Ky., Oct. 3, 1889.

The Refuse Oil Works, Vicksburg, Miss., are going to have an electric light plant.

The Fort Wayne Jenney Company will put another dynamo in the plow factory of B. F. Avery & Sons.

The New Albany, Ind., Cotton Mills are increasing their incandescent plant, and have added another 200-light machine.

The Gaynor Electric Company are installing an incandescent plant at the Peerless Manufacturing Company's building on Eighteenth street.

Electric Roads.—The Gaynor Electric Company, of this city, has been awarded the contract for the electrical equipment of the South Nashville Street Railway Company by the Sprague system.

The Lee Steamship Line, on the Mississippi, have recently equipped their six boats, the "Rosa Lee," "Jim Lee," "Lady Lee," "Ruth," "Gayoso," and "Gohamma," each with three arc lamps of 2,000, and a focusing lamp and reflector for landing purposes.

The Fall Celebration here is now taking all the capacity of the dynamos at the light station, as hundreds of lamps are strung in front of many stores and give a very pleasing effect. The display in front of Julius Winter's store, on Third and Market, attracts a good deal of attention. W. J. F.

CANADIAN NOTES.

PORT HOPE, Can., Oct. 1, 1889.

The Port Hope Electric Light and Power Company, Limited, is in successful operation, and is about adding electric power to its lighting business. It has a capacity of 80 arc lamps of the Ball system and 650 incandescents of the Fort Wayne Jenney system. It is run by water power, and the surplus power is to be utilized for electric motors. The arc plant has been in operation four years, and it is claimed that the lights are as good as any seen in Canada, being steady, white, clear and without a flicker. The capital stock of the company is $49,000.

THE TELEGRAPH.

The Von Rysselberghe System has, it is said, been adopted on the Chinese telegraph lines.

Tall Telegraphy.—The French administration of telegraphs have established a public telegraphic office on one of the platforms of the Eiffel Tower.

The Railway Telegraph Superintendents will hold their annual meeting at Washington, Oct. 16, the convention being held at the Ebbitt House.

Growth in Minnesota.—The Western Union Company have 4,931 miles of active route in Minnesota, and the gross earnings of 885 offices and stations are $110,903.

The Southwestern Telegraph Company has been formed at Chicago to build and operate lines in Illinois and elsewhere, by W. O. Hall, F. P. Meynberg, J. H. Silveia, and Y. C. Spencer.

T. M. B. A. Assessment No. 234, for October, has been made to meet the death claims of Mrs. H. M. Ogle and A. T. Lee. The annual meeting of the Association is to be held in this city on November 20.

The Signal Service.—Chief Signal Officer Greeley has been ordered on an inspection trip to St. Louis and other Western cities. Second Lieut. Frank Green, Signal Corps, has been ordered to superintend the removal and reconstruction between Holbrook and Fort Apache, Ariz., of the telegraph line now operated between Prescott and Phœnix. Ariz.

The Searle-O'Connor Boat Race is the subject of a pretty folder issued by the Commercial Cable Company, to show how big a hit they scored in their early reports of the race. The folder contains a number of Canadian newspaper comments on the quick work of the Commercial Company. Mr. George Ward thinks that his cable staff made decidedly better time than even Searle himself.

THE TELEPHONE.

The Edison Phonograph Toy Manufacturing Company, Boston, have mailed a circular to their stockholders detailing the increase of stock by 40,000 shares, making the total 100,000 shares, of $10 each. Part of this new stock, 24,000 shares, has been issued in consideration of old contracts canceled. The factory capacity is now 500 dolls a day, and Mr. E. S. Allien is now in Europe buying dolls to contain the phonographs. The new toy talking doll is expected to be ready for the Christmas holiday trade.

THE ELECTRIC LIGHT.

Covington, Ky.—Overman & Shrader want a 50-incandescent light plant.

Somerset, Ky.—The De Coppet Ice Company want to put in an electric light plant.

Lexington, Va.—Mr. C. W. Irvine expects a franchise and will want bids on the equipment.

Lighting the Tomb.—A rich citizen of Vienna, who disliked darkness, has his tomb lit with electric lights.

Rutland, Vt.—The Marble City Electric Company will establish a plant in the old rink, which it has secured for a station.

Milledgeville, Ga.—The Milledgeville Oil and Fertilizer Company made a contract with the Brush Electric Company for a plant and will also light the city. It is also proposed to utilize the actual water power electrically.

Tampa, Fla.—R. Mugge, Tampa, has been granted a permit to string wires and erect poles along the streets of that city for distributing electric lights. Mr. Mugge is pushing matters, and proposes to have his lights burning by Nov. 1. He has contracted with the Heisler Electric Light Company, of St. Louis, for their system of long-distance incandescent lighting, and is preparing buildings and steam plant sufficiently large to permit of their being increased to three times the original capacity.

Bonham, Texas.—The Bonham Electric Light and Power Company has effected an organization with Dr. Benjamin Dabney as president, and John W. Russell, treasurer. A 30 years' franchise has been granted the company and a contract for lighting the city for the same length of time. They have placed their orders for apparatus with the Heisler Electric Light Company, of St. Louis, manufacturers of the well-known long-distance system of incandescent lighting. The capital stock is $20,000. The plant will include 300 incandescents and 20 Sperry arcs.

Westinghouse Earnings.—According to the Boston *Advertiser*, Mr. George Westinghouse, Jr., hopes to favor the stockholders of the Westinghouse Company about Jan. 1 with a complete statement of earnings and fixed charges. The September sales of the company were $358,000, with one day to be added, not including a special contract for $140,000; a total of a little over $500,000. For 1889 Mr. Westinghouse estimates the net earnings at $1,200,000. The rentals and 6 per cent. dividends call for about $450,000. The Sawyer-Man light is earning the whole dividend paid on Westinghouse electric stock.

The National Electric Light and Power Company, of Philadelphia, has just completed a 75 light plant in the machine shop of Alfred Box, corner Brown and Front streets. A plant is also being installed of 50 lights for Mr. G. Rebman, iron founder, corner Thirteenth and Noble streets. Besides these two plants the company is installing an initial outfit for the Park Mills, corner Howard and Norris streets, preparatory to putting in a complete equipment for the entire mill. The residence of Mr. H. P. Dixon is being wired by this company for the installation of a plant for 300 lights. General Manager Erb and Assistant Hague have all they can attend to in the way of furnishing estimates for isolated installations.

Southern Notes.—The Natural Bridge Forest Association, Va., has been formed by H. C. Parsons and others, and will put in an electric light plant, etc. Carter, Lloyd & Carter, Dallas, Tex., are putting a plant in their flour mill. The Kimball Lumber Company, Apalachicola, Fla., are putting a plant in their lumber mills. The Franklin, Tenn., Electric Light and Power Company will put in a Thomson-Houston plant. W. S. Wilson and others, Snow Hill, Md. have bought a plant and will put up a new station, with new boiler and engine. The Helena, Ark., Electric Light Company is going into the incandescent business. A local company has been formed at Keyser, W. Va.

Long Distance Lighting.—THE ELECTRICAL WORLD of Sept. 28 contains an illustrated article descriptive of the long-distance lighting plant at 64 South State street, for Englewood. A plant to be operated under somewhat similar conditions is now being installed at Cicero, a few miles to the west of the heart of the city but practically a western ward of Chicago. Mr. J. W. Scoville (a prominent Western philanthropist and capitalist), president of the Cicero Water, Gas and Electric Light Company, has closed a contract with Dr. Thomas Addison, of Chicago, for the immediate installation of 1,950 incandescent lamps of the Thomson-Houston alternating system, to be followed by an additional 2,000 lights as soon as the circuits can be erected. This important deal insures the lighting of the suburbs with electricity.

The D. A. Tompkins Company, of Charlotte, N. C., report the following list of recent sales of Westinghouse apparatus: Charlotte Oil and Fertilizer Company, Charlotte, N. C., 150 D. C. incandescent; Nashville Light and Power Company, Nashville, Tenn., 1,500 A. C. incandescent; Sumter Light and Water Company, Sumter, S. C., 500 A. C. incandescent; Sumter Light and Water Company, Sumter, S. C., 35 arc; Gate City Oil Company, Atlanta, Ga., 150 D. C. incandescent; Gate City Oil Company, Madison, Ga., 25 D. C. incandescent; Gate City Oil Company, Jackson, Ga., 25 D. C. incandescent; Gate City Oil Company, Covington, Ga., 25 D. C. incandescent; Darlington Gin and Mill Company, Darlington, S. C., 59 D. C. incandescent; Marion Oil Company, Marion, S. C., 50 D. C. incandescent; State Insane Asylum, Columbia, S. C., 400 D. C. incandescent; State Insane Asylum, Columbia, S. C., 5 arc; Alpha Manufacturing Company, Charlotte, N. C., 100 D. C. incandescent; Florence Light and Power Company, Florence, Ala., 500 A. C. incandescent; Florence Light and Power Company, Florence, Ala., 40 arc; Merchants and Planters Oil Company, Houston, Texas, 150 D. C. incandescent; Edison Electric Light and Power Company, Birmingham, Ala., 1,000 A. C. incandescent; Independent Oil Company, New Orleans, La., 150 D. C. incandescent; Montgomery Oil Works, Montgomery, Ala., 50 D. C. incandescent; Enoree Manufacturing Company, Enoree, S. C., 500 D. C. incandescent; Chattahoochee Knitting Mill, Columbus, Ga., 100 D. C. incandescent; Montgomery Brewing Company, Montgomery, Ala., 50 D. C. incandescent; H. Dudley Coleman, New Orleans, La., 100 D. C. incandescent.

APPLICATIONS OF POWER.

Rusk, Tex.—The Rusk & New Birmingham Street Railway Company will operate by electricity.

The Robinson-Foster Motor Company have begun work again at Peabody, Mass., in a small way.

The Raleigh, N. C., Street Railway Company is about converting its plant into an electrical one.

Petersburg, Va.—An electric road is to run from Richmond, to Petersburg. Major B. J. Black is interested.

Des Moines, Ia.—The electric road at Des Moines carried 90,000 people during State Fair week, giving an income of $4,500 for that period.

Birmingham, Ala.—The Electric Traction and Manufacturing Company, of New Orleans, are to put a storage car in operation at Birmingham.

Hopkinsville, Ky.—Mr. S. H. Turner writes us that he has secured for himself and others a franchise from the city of Hopkinsville to build an electric street railway and an electric light plant. A company will be formed in the near future to carry out the work.

Brooklyn, N. Y.—The Montague Street Railroad Company has obtained the Montague street franchise by bidding 100 per cent. of the gross receipts for it, and giving a bond of $25,000. Electricity is to be used, it is said. The Bentley Knight system was specified at one time.

Peoria, Ill.—The Thomson-Houston road at Peoria, Ill., has gone into successful operation. The overhead system is used. Power is furnished to two generators of 100 h. p. capacity each by a Reynolds-Corliss engine of 250 h. p. Mr. E. Verstraete has been in charge of the electrical work, assisted by Mr. R. Hensler. The road is owned by the Central Railway Company, of which Mr. S. A. Kinsey is president; Mr. C. R. Wheeler, secretary; Mr. H. R. Woodward, treasurer, and Mr. E. Tetu, cashier.

PERSONALS.

M. Roman, of Paris, France, who is now in this city, is understood to represent the Pieper arc-incandescent lamp illustrated in our last issue.

Mr. W. E. Lewis, superintendent of telegraph on the Long Island Railroad, has been appointed superintendent of the road and has assumed his new duties.

Mr. T. A. Edison returned home by the French steamer "La Champagne" and was received by a large gathering of his friends, who went down the Bay to meet him.

Mr. H. McL. Harding has already left New York for Chicago, and will immediately enter upon his new work in the latter city. He has leased the residence formerly occupied by Mr. H. Ward Leonard.

Mr. E. T. Lynch, Jr., the chairman of the National Electric Light Association Committee formed on the subject, has issued a circular of inquiry to street railway companies as to the potential they use, etc.

Mr. J. H. Bass, of Fort Wayne, Ind., is said to have sold to an English syndicate his extensive foundry and machine shops in that city, St. Louis and Chicago, together with Alabama iron mines for which he refused $3,000,000 a year ago.

Mr. Frank T. Brown has resigned his office of Principal Examiner in charge of Division A of the class of electricity in the Patent Office. Mr. Brown, it is understood, is to enter the practice of patent law and soliciting in partnership with ex-Commissioner of Patents Benjamin Butterworth.

Mr. Denison Dalziel, the editor of *Truth*, proposes to call his new cable news company the Dunlap, Mr. Robert Dunlap being the president and a large stockholder. Mr. Dalziel will be the president of the European company. A special feature will be the supply of reliable American news to English and European journals.

Mr. C. D. Jenney has an interesting interview in the Indianapolis *News* on the subject of the advantages of electric power, and offers an ingenious suggestion as to utilizing natural gas in generating electricity for light and power. "The one central plant complete and extensive enough to supply every demand which would be made upon it would cost less than a gas main round the Belt."

Mr. Brainard Rorison is receiving a great many expressions of regret at Indianapolis on his removal to Fort Wayne to take charge of the new three million dollar company' work and manufacturing there. In his departure, Indianapolis loses one of its brightest, most active and most influential citizens. The plant of the old Indianapolis Jenney Company will be transferred to Fort Wayne.

Supt. Frank Mason, of the Brooklyn police telegraphs, spent some time last week ciceroning Capt. W. Douglas, Chief of the San Francisco police, who is in the East inspecting police telegraph and patrol systems. Mr. Mason also had a visit from Police Commissioner B. B. Cardwell, of Portland, Ore. Both were greatly interested and pleased with what they saw of the operations of Mr. Mason's department.

Mr. T. D. Lockwood will read a paper before the American Institute of Electrical Engineers on Tuesday, Oct. 15, at 8 P. M., at the College of the City of New York, entitled "Electrical Notes of a Transatlantic Trip," in which he will deal with a variety of interesting electrical topics that came under his observation while in Europe this summer. Mr. Lockwood's well-known ability promises a paper of surpassing interest and value to all engaged in electrical pursuits.

Mr. Oscar T. Crosby, who for the past three years has occupied an important position with the Sprague Electric Railway and Motor Company, has severed his connection with that company to assume charge of the Weems electric rapid transit enterprise. The unvarying courtesy and kindness which distinguished Mr. Crosby's intercourse with others won for him a respect and friendship second only to the esteem in which he is held by the officers and agents of the Sprague Company and those doing business with it. When Mr. Crosby's resignation was announced, $200 was immediately subscribed by the officers, employés and such agents as heard of the matter, as well as by several gentlemen who have business relations with the company. A handsome gold watch was then selected and suitably inscribed; and this, together with an appropriate chain and locket, was presented to Mr. Crosby on Sept. 28. The recipient was much pleased at this substantial testimonial of the esteem of his associates, but in tendering his thanks expressed himself as even more touched by the long list of names accompanying it.

MISCELLANEOUS NOTES.

The Magnetic Club will hold its autumn meeting at Martinelli's Restaurant, Fifth avenue, on Thursday, Oct. 17. Dinner will be served at 6.30 P. M.

The St. Paul Electrical Construction Company, New York Life Insurance Building, St. Paul, has recently been organized, with bright prospects for a large business. It will carry a full line of electrica supplies and will undertake all kinds of construction. Mr. John Lund is the general manager.

The Franklin Institute Lectures this year will include a number of electrical topics, as follows: Dec. 16, Mr. R. W. Pope on "Electricity, its Past, Present and Future;" Jan. 20, Lieut. B. A. Fiske, U. S. N., on "Electricity in Warfare;" Feb. 3, Dr. Louis Duncan, "Modern Conceptions of Electricity" (illustrated); Feb. 10, Mr. Eugene Griffin, "Electric Railways."

The Boston "Advertiser," of Sept. 28, is a special electrical edition, in which eight pages are devoted to illustrations and descriptions of all kinds of electrical apparatus and appliances, and these are accompanied by various original articles from well-known writers. A number of portraits are also given of well-known electrical inventors, electrical engineers and electrical business men. The selections of representative men are well made in every instance.

Okonite Wire gets a Gold Medal at the Paris Exposition.—As stated in our columns last week, the Okonite Company received at the Paris Exposition a gold medal. The exhibit of the Okonite specialties, which can be seen from all parts of the building wherein it is located, includes a full line of Candee aerial wires and Manson and Okonite tapes. The wiring of the American Bell Telephone Company's exhibit and also the Western Electric Company's exhibit was done with Okonite wire.

The Electrical Accumulator Company in availing itself of the decision of Judge Coxe sustaining the Faure patents, recently filed bills in equity against Henry D. Thayer and the Western Electric Company, of New York, who were using a secondary battery made by the Woodward Electric Company, of Detroit, commonly known as the "Detroit Battery." A preliminary injunction was asked for and granted by Judge Lacombe on Oct. 4. The same complainant about the same time filed bills in equity against the Citizens' Electric Illuminating Company, of Brooklyn, who were using a battery made by the Mutual Electric Manufacturing Company, of Brooklyn, which infringed the three patents of Faure and a key-lock patent of Sellon. The preliminary injunction asked for in this case was also granted by Judge Lacombe.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidentally grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

Patterson, Gottfried & Hunter (Limited), 146-148 Centre street, carry a complete stock of brush copper, celluvert fibre led paper, hard rubber, rod and sheet brass, brass, copper and iron wire, self-hardening tool steel, set and cap screws, machine bolts, machine and wood screws, taps and dies, files and twist drills, blowers and forges, machinery, tools and hardware, gear wheels, wood pulleys, shafting hangers and belting. General factory supplies.

Houston's Electrical Dictionary.—The New York *Herald* says of Prof. E. J. Houston's "Dictionary of Electrical Words, Terms and Phrases:" "A book of this kind is absolutely necessary to the general reader who wishes to understand any modern article on applied electricity, and Mr. Houston's book seems to answer the purpose. It contains more than six hundred pages, and the definitions are often more suggestive of cyclopædia than dictionary, which is a virtue instead of a fault. The pages abound in illustrations."

The Ball Engine Company, of Erie, Penn., manufacturers of the Ball engine, report the following shipments for September: Brooklyn Street Railway Company, Cleveland, O., two 125 h. p. engines; Williamette Bridge Street Railway Company, Portland, Ore., one 80 h. p.; Seattle Electric Railway and Motor Company Seattle, Wash., one 80 h.p.: Edison Electric Illuminating Company, Brooklyn, N. Y., one 300 h. p.; Meridian Oil Mills Company, Meridian, Miss., one 200 h. p.; Akron Street Railway Company, Akron, O., one 150 h. p.; Westchester County Electric Light Company, Rye, N. Y., one 80 h. p.; Bellaire Gas and Electric Company, Bellaire, O., one 80 h. p.; Citizens' Electric Light and Power Company, Covington, Ky., one 50 h. p.; Marion Cotton Mills, Marion, S. C., one 50 h. p.; Pioneer Iron Works, Cienfuegos, Cuba, one 60 h. p.; State Reformatory, St. Cloud, Minn., one 50 h. p.; Thomson-Houston Electric Light Company, Wilmington, N. C., one 100 h. p.; Sheridan Iron Works, Champlain, N. Y., one 80 h. p.; Thomson-Houston International Electric Company, Iquiqui, Chili, one 25 h. p.; August Klönne, Dortmund, N. Germany, one 35 h. p.; Redonda Hotel Company, Los Angeles, Cal., one 100 h. p.; Murphy Varnish Company, Newark, N. J., one 25 h. p.; Tacoma and Roach Harbor Lime Company, Roach Harbor, Wash., one 80 h. p.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED OCTOBER 1, 1889.

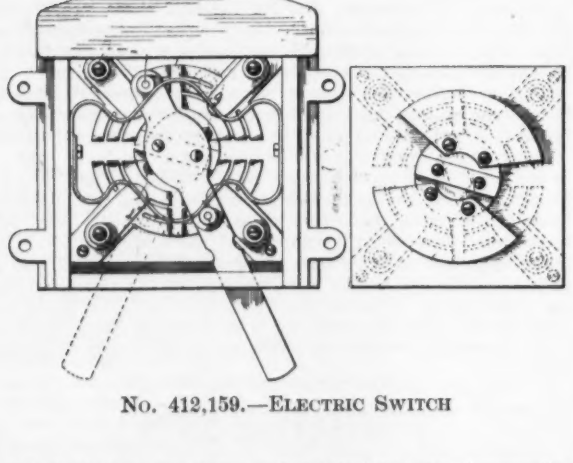
411,772. Hotel Electrical Annunciator Circuit; Charles G. Armstrong, of Englewood, Ill., Assignor to the New Haven Clock Company, of New Haven, Conn. Application filed July 1, 1889. This invention relates to the class of electrical appliances used in hotels for the purpose of communicating between the rooms of the guests and the central office of the hotel, and it is an improvement on the device commonly known as "Porter's electric messenger."

411,782. Governor for Electro-Dynamic Machines; George F. Card, of Covington, Ky., Assignor to the George F. Card Manufacturing Company, of Cincinnati, O. Application filed Oct. 29, 1888. In an electro-dynamic machine, or motor, the combination of the armature, the centrifugal speed governor revolable synchronously therewith, the field magnets having the differential circuit wound in the reverse direction to the drive circuit, said differential circuit having a vibrating terminal connected to and operated by the governor, and the opposing relatively stationary terminals on opposite sides of the vibrating terminal.

411,783. Governor for Electro-Dynamic Machines; George F. Card, of Covington, Ky., Assignor to the George F. Card Manufacturing Company, of Cincinnati, O. Application filed Feb. 1, 1889. In a governor for an electro-dynamic machine or motor, the combination, with a differential neutralizing circuit of an elastically pivoted lever and two carbon points for making or breaking the differential circuit, so arranged that a velocity of the machine beyond the maximum fixed, moves the lever and closes the circuit through the carbon points until the velocity is reduced.

411,786. Method of Forming Plates for Secondary Batteries; Stanley C. C. Currie, of Philadelphia, Pa., Assignor to the United Electric Improvement Company, of Gloucester City, N. J. The improvement in the method of forming elements of electrical accumulators, which consists in converting the plates into the peroxide state while confined against expansion.

411,787. Apparatus for Forming Secondary Battery Plates; Stanley C. C. Currie, of Philadelphia, Pa., Assignor to the United States Electric Improvement Company, of Gloucester City, N. J. Application filed Jan. 31, 1889. The combination of the plate of active material, its inclosing rim, the closely fitting



No. 412,159.—Electric Switch

detachable inclosing frame, and the electrical circuit connections constituting an electrode, whereby the plate may be removed or inserted without affecting the electrical contacts of the elements.

411,801. Wire Holder and Insulator; John R. Fletcher, of Dayton, O. Application filed March 16, 1889. As a new article of manufacture, the wire holder comprising a body with a longitudinal groove to receive insulators and the screw an integral part thereof, and binding screws.

411,833. Electric Motor; Charles C. Beck, of Middlebury, Va., Assignor to the Giant Electric Motor Company, of Kittery, Me. Application filed Sept. 25, 1888. In an electric machine or motor a series of fixed electro-magnets and a second series of electro-magnets movable about an axis parallel to its own magnetic axis, and having its surface adjacent to the fixed electro-magnet made eccentric to the axis of revolution, but more nearly concentric with its own magnetic mass, one series of magnets being wound to produce reversals of polarity in each of its magnets, as each magnet of the other series is revolved by each magnet of the first series of magnets.

411,840. Automatic Synchronizing Commutator; Robert S. Taylor and Marmaduke M. M. Slattery, of Fort Wayne, Ind. Application filed June 26, 1889. An automatic pole changer consisting of two motors having a common shaft, one of them being an induction motor for initial action and the other an alternating current motor adapted to operate synchronously with the dynamo generating the current to be commuted and carrying upon its armature shaft a commutator, through which the commutation is effected.

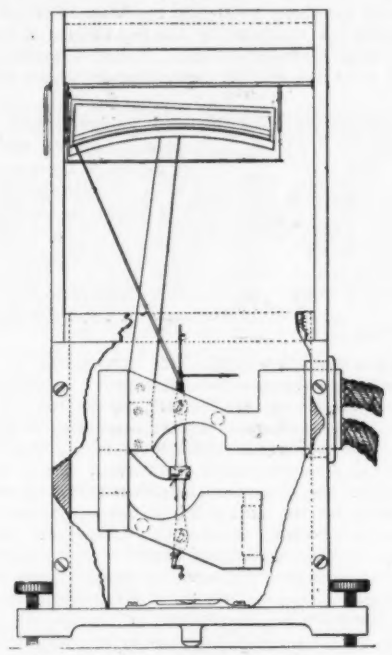
411,899. Electro-Magnetic Separator; Richard R. Moffatt, of New York, N. Y., Assignor by direct and mesne assignments to the Moffatt Electric Construction Company, of New York. Application filed Aug. 9, 1888. An electro-magnetic separator, having one or more electro magnets that are energized by means of an alternating electric current.

411,908. Electric Valve Device; Frank Stephens, of Philadelphia, Pa. Application filed Aug. 9, 1889. In an electric valve device, the combination of the supply pipe, a weighted valve in the line thereof, a standard on the pipe, a lever pivoted to the standard and connected to the valve, a detent adapted to engage the free end of the lever, a spring, a weight connected to the detent, a pivoted dog normally carrying said weight, and an electro-magnet and connection controlling the dog.

411,930. Station Switch Board and Connection; Edwin Wilbur Rice, Jr., and Albert L. Rohrer, of Lynn, Mass. Application filed July 29, 1889. Consists, essentially, in the combination with electric switches controlling the connection of the dynamos in multiple arc to electric mains or conductors of supplemental switch contacts controlled by each of such switches and placed in the circuits from the dynamos to a wire or connection forming with such contacts an equalizing connection.

411,935. Cut-Out; Albert P. Seymour, of Syracuse, N. Y. Application filed Jan. 3, 1889. The invention consists, essentially in the combination, with the line contact of the cut-out switch of an arc-rupturing magnet, whose coils are in a connection between the opposite pole of the line and the movable switch contact, so that even after contact is fully established with the branch contact the magnet will still have its coils in circuit and will blow out any arc tending to continue after full establishment of connection with the branch.

411,936. Carbon Clamp for Arc Lights; Albert P. Seymour, of Syracuse, N. Y. Application filed July 26, 1889. A detachable clamp for carbon carriers having its body slit trans-



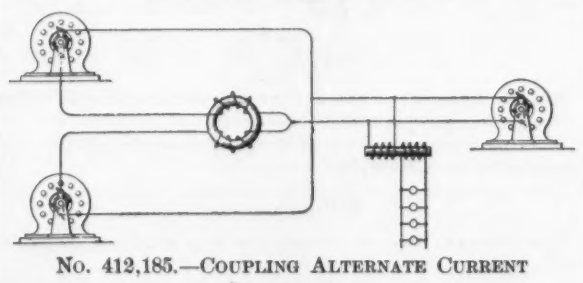
No. 412,140.—Galvanometer.

versely at the part where it connects with the carbon carrier, and provided with carbon clamping devices which tend to draw the two sides of the clamp body together against the carrier.

411,947. Rheostat; Merle J. Wightman, of Lynn, Mass. Application filed July 5, 1889. The invention consists in a novel electric resistance pile, comprising alternate layers or sheets of conducting and insulating material piled together, and having each conducting strip or layer connected at one end, or to one side of its centre, to the strip adjoining it at one side and at its other end or side of its centre to a strip or sheet of conducting material adjoining it on the other side.

411,950. Armature; Arthur S. Atwater, of Cleveland, O. Application filed March 28, 1889. Laminæ consisting of wrought-iron plates cut out with the passages and shaft hole and having the channels stamped nearly radially to afford air escape.

411,970. System of Electrical Distribution for Street-Lighting; Oliver B. Shallenberger, of Rochester, Assignor to the Westinghouse Electric Company, of Pittsburg, Pa. Application filed Oct. 16, 1888. The invention consists in so proportioning the coils and core of each of a number of converters, which have their primary coils connected in series, in an alternating current electric circuit, and their secondary coils respectively including in their circuits an incandescent lamp or other translating device, that, when the lamp is in circuit and receiving its proper current, sufficient current will be allowed to traverse the primary coil of each converter to supply all the remaining converters in circuit, and when the secondary circuit of any converter is interrupted a consequent high magnetic saturation



No. 412,185.—Coupling Alternate Current Generators.

of the core will cause the reactive effect of the primary coil to be so modified as to oppose to the current an effective resistance approximately equivalent to that which exists when the lamp is in circuit.

(1) 411,982. (2) 411,983. Electric Motor; Philip Diehl, of Elizabeth, N. J. Applications filed April 20, 1889. The combination, with a shaft to be driven and a sleeve secured to said shaft, of an electric motor comprising a stationary field magnet and an armature, forming part of a wheel which has a hub mounted loosely on said sleeve, a clutch disc rotatively connected with said sleeve, but adapted to slide thereon into or out of engagement with said wheel, and an arm or lever for pressing said disc into frictional contact with said wheel when desired.

411,989. System for Electric Conductors for Electric Cars; Charles Almon Jackson, of Billerica, Mass. Application filed April 20, 1889. In a system for electric conductors for cars, the combination of a double armed trolley extending laterally from the car and having trolley wheels, as described, with the conducting wires and with supporting brackets.

412,045. Watchman's Clock Station; James F. Scribner, of Newark, N. J., Assignor to the E. Howard Watch and Clock Company, of Boston, Mass. Application filed Dec. 17, 1888. The special object of this invention is to provide means for operating the mechanism of the station preparatory to transmitting its record without leaving an opening in the case in such a position and of such dimensions that any one malicious or mischievous can operate the station without using the special key provided for the purpose, or render the station inoperative by introducing into the opening any foreign substance.

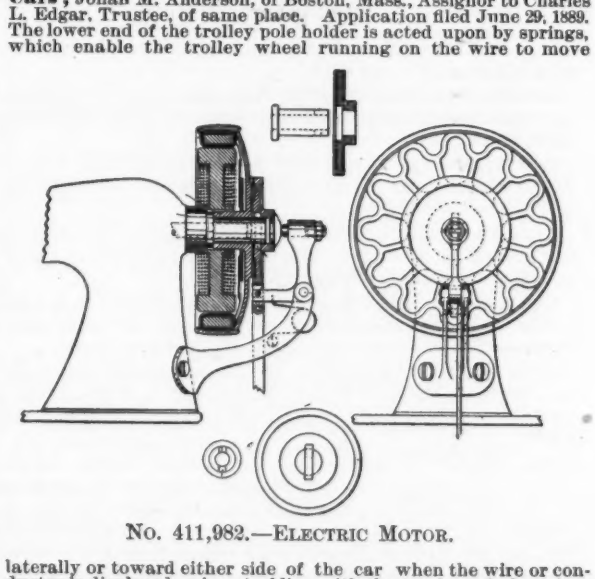
412,095. Electric Subway; Isaac La Rue Johnson, of Washington, D. C., Assignor of one-half to Oliver T. Thompson, of same place. Application filed July 23, 1889. A conduit for electric cables and conductors, having a water repellent non-contacting lining or shell therein which conforms to the outline of said conduit and having brackets thereon for the support of said cables and conductors.

412,140. Galvanometer; William Thomson, of Glasgow, County of Lanark, Scotland. Application filed March 29, 1888. Patented in England Aug. 9, 1884; in France, April 11, 1885, and in Belgium, April 29, 1885. In an apparatus for measuring electric currents the combination of a movable mass of soft iron having the ratio of its greatest to its least diameter comparatively small, an indicator connected therewith, and an adjacent conductor having approximately equal fields of electro-magnetic force on both sides of said soft iron mass, and being wound or shaped so that the current passing through it will produce a non-uniform field of electro-magnetic force about the said soft iron mass.

412,141. Arc Light; Friedrich Von Hefner-Alteneck, of Berlin, and Carl Hoffmann, of Charlottenburg, Prussia, Germany. Application filed April 15, 1889; patented in Germany June 25, 1887; in Belgium Nov. 16, 1887; in France Nov. 16, 1887; in Italy Dec. 31, 1887; in Norway Jan. 7, 1888, and in Austria-Hungary Sept. 25, 1888. In an electric arc lamp, the combination, with a carbon carrier and a drum, of a flexible conductor of electricity carrying the carbon carrier and wound upon the drum, from which it is unwound by the weight of the carbon carrier, a reacting device connected with the said drum which winds the flexible conductor thereon when relieved of the weight of the carrier, a pivotally mounted frame carrying the said drum, and a pendulous escapement also carried by the frame and regulated in its operation by the inclination thereof.

412,155. Trolley for Electric Railway Service; Albert Anderson, of Boston, Mass., Assignor to Charles L. Edgar, Trustee, of same place. Application filed May 21, 1889. A trolley provided with a detachable contact shell, made, preferable, as a ring, somewhat concaved at its periphery, the said shell being easily removed from or applied in position between the usual flanges or sides of the trolley and its hub or axle.

412,157. Trolley Attachment for Electric Railway Cars; Johan M. Anderson, of Boston, Mass., Assignor to Charles L. Edgar, Trustee, of same place. Application filed June 29, 1889. The lower end of the trolley pole holder is acted upon by springs, which enable the trolley wheel running on the wire to move



No. 411,982.—Electric Motor.

laterally or toward either side of the car when the wire or conductor is displaced or is out of line with the track, and also when the car is running on a curved part of the track.

412,159. Electric Switch: Fred M. Bennett, of New York, N. Y., Assignor of one-half to William Carroll, of same place. Application filed April 8, 1889. The switch is of the double pole variety, and is of such construction that the terminals of the two circuits which it controls may be changed from one pair of binding posts to another, as convenience dictates, without altering the action of the switch.

412,165. Electrode for Medical Batteries; Harry Barringer Cox, of New Haven, Conn., Assignor to the H. B. Cox Electric Company, of same place. Application filed March 8, 1889. An electrode consisting of a hollow, pliable elastic cylinder formed of coiled spring wire.

412,177. Electric Motor; Henry Groswith, of Philadelphia, Pa., Assignor of three-fourths to Charles W. Kennedy and Ransom F. Rankin, of same place. Application filed July 30, 1889. The combination of the armature proper, a movable disc or plate provided with radial metallic conduit plates or sectors adapted to connect the termini of the wire coils in the manner described, and the removable box or bearing carrying the radial contact or commutator plates arranged in a vertical plane and connected at their inner ends to the corresponding sector-plates.

412,185. Coupling Alternate Current Generators; John Hopkinson, of Westminster, county of Middlesex, and Edward Hopkinson, of Manchester, county of Lancaster, Eng., Assignors to George Westinghouse, Jr., of Pittsburgh, Pa. Application filed June 4, 1887. Renewed April 20, 1889. The combination, with the direct and return conductors of an electric circuit, of two or more alternate current dynamo electric machines connected thereto in parallel with each other, and one or more self-induction coils included in the circuits of said alternate machines.

412,186. Method of Synchronizing Alternate-Current Generators; John Hopkinson, of Westminster, county of Middlesex, and Edward Hopkinson, of Manchester, county of Lancaster, England. Application filed May 24, 1889. The method of synchronizing alternate-current electric generators which consists in causing the excess of current from one generator to induce an assisting current in the circuit of the other generator and thereby temporarily lessen the load of that generator.

412,196. Electro Therapeutic Appliance; John S. Mellon, of St. Louis, Mo., Assignor of six-tenths to G. W. Lewis, of same place. Application filed June 22, 1889. A galvanic pair the electrodes of which are adapted to be artificially excited electrically by the moisture of any part or parts of the human system as that or any other organized life from its contact therewith, in combination with a ground conductor connecting the pair with the earth.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times building, N. Y.

SUPPLEMENT TO THE

ELECTRICAL WORLD

VOL. XIV. OCTOBER 12, 1889. No. 15.

THE BRADLEY DECISION IN THE SAWYER-MAN FIBROUS FILAMENT CASE.

Since sending our regular edition to press on Monday morning, we are in receipt of the complete text of the decision at Pittsburgh in the Sawyer-Man fibrous filament patent case. We therefore print it in full herewith and issue it in supplement form simultaneously with the paper itself.

UNITED STATES OF AMERICA, } ss:
WESTERN DISTRICT OF PENNSYLVANIA. }

(L. S.) I, H. D. Gamble, Clerk of the Circuit Court of the United States for said District, do hereby certify that the writing hereto annexed is a transcript of the original thereof on file and remaining of record in my office, in the cause therein mentioned.

Witness my hand and the seal of said Court, at Pittsburgh, in said District, this fifth day of October, A. D. 1889. H. D. GAMBLE, Clerk.

CIRCUIT COURT OF THE UNITED STATES, }
FOR THE WESTERN DISTRICT OF PENNSYLVANIA. }

The Consolidated Electric Light Company, Complainant vs. McKeesport Light Company, Defendants.—No. 5, May Term, 1888.

ON BILL AND FINAL HEARING. OPINION OF THE COURT.

Bradley, Circuit Justice.

This is a bill for the alleged infringement of a patent, filed Dec. 8, 1887, and the patent alleged to be infringed is dated May 12, 1885, and is for improvement in electric lamps. It was granted upon the application of William E. Sawyer and Albon Man, of New York, to their assignees, the Electro-Dynamic Light Company, and by mesne assignments was transferred to the complainant, whose title commenced in October, 1882, before the patent was issued. The application for the patent was filed Jan. 9, 1880, and the issue was delayed by various proceedings in the Patent Office, including an interference with an application of Thomas A. Edison, which had been filed a month earlier, to wit, Dec. 11, 1879. Various defenses were set up in the Answer, such as anticipation by prior inventors, vagueness of description, want of novelty and utility, undue change of specification after filing, surreptitious claim of an invention made by Edison, etc. It is conceded that the defense of the suit is conducted by Edison Electric Light Company, a corporation of New York, which sells the lamps complained of as infringements of the patent, and is interested as assignee in the patents for electric lights formerly owned by "The Edison Electric Light Company," and in the question of interference between Edison and the complainants.

In the specification of the patent sued on, called Sawyer and Man patent, the invention is described as relating to that class of electric lamps employing an incandescent conductor enclosed in a transparent hermetically sealed vessel or chamber, from which oxygen is excluded, and constituting an improvement upon the apparatus shown in a previous patent granted to the same parties (Sawyer and Man), June 18, 1878, and numbered 205,144.

It is further stated in the specification that the invention relates more specially to the incandescent conductor, its substance, its form and its combination with the other elements composing the lamp, and that the improvement consists, first, of the combination in a lamp chamber, composed wholly of glass, as described in the said former patent, of an incandescent conductor of carbon made from a vegetable fibrous material, in contradistinction to a similar conductor made from mineral or gas carbon, and also in the form of such conductor combined in lighting circuit within the exhausted chamber of the lamp.

The construction of the lamp is then described, reference being made to the drawings for illustrations. The lamp, as described and shown in the drawings, is a glass cylinder with rounded top, cemented at the bottom to a glass disc or plate, ground to fit closely to the cylinder, and the whole bottom inclosed in a cup filled with wax or suitable cement, to prevent as far as possible the access of atmospheric air. Two holes are made in the bottom of the lamp for the passage of the wires which convey the electric current into and out of the lamp. The carbon conductor within the glass cylinder is connected by its extremities to these two wires, respectively, in a mode specified in another patent of Sawyer and Man, dated Dec. 10, 1878, and numbered 210,809, so as to constitute a part of the circuit; and having a low conductivity, and presenting a certain amount of resistance to the current of electricity, it becomes incandescent and highly luminous. If the carbon in this condition were exposed to atmospheric air, that is, to oxygen, it would be consumed by combustion. Hence another part of the combination necessary to the result consists in filling the lamp with nitrogen gas, or other gas, which prevents combustion, to the exclusion of atmospheric air. The mode of doing this is pointed out in the patent, No. 205,144, before referred to.

It is further stated in the specification that in the practice of the invention, the applicants had made use of carbonized paper, and also wood carbon. Also, that they had used conductors of different shapes such as V-shaped, and with rectangular corners, but preferred the arch-shaped, as shown in the drawings. It is added that a description of the mode of making the illuminating carbon conductors described, "and making the subject matter of this improvement," was necessary, as they could be made by any one skilled in the art, by the ordinary well-known methods in practice.

The specification then states the proposed practical advantages of the arched form of the conductor, by its permitting the carbon to expand and contract and casting less shadow, and the advantage of making the wall of the lamp wholly of glass, by its preventing oxidation, leakage, etc., and states particularly the advantages resulting from the manufacture of the carbon from vegetable, fibrous or textile material instead of mineral or gas carbon. "Among them," it says, "may be mentioned the convenience afforded for cutting and making the conductor in the desired form and size, the purity and equality of the carbon obtained, its susceptibility to tempering, both as to hardness and resistance, and its toughness and durability." "We have used," it is added, "such burners in closed or hermetically sealed transparent chambers, in a vacuum, in nitrogen gas and in hydrogen gas; but we have obtained the best results in a vacuum, or an attenuated atmosphere of nitrogen gas, the great desideratum being to exclude oxygen or other gases capable of combining with carbon at high temperatures from the incandescing chamber, as is well understood."

The patent has four claims:

"1. An incandescing conductor for an electric lamp of carbonized fibrous or textile material, and of an arch, or horseshoe shape, substantially as hereinbefore set forth.

"2. The combination, substantially as hereinbefore set forth of an electric circuit and an incandescing conductor, of carbonised fibrous material, included in and forming part of said circuit, and a hermetically sealed chamber in which the conductor is inclosed.

"3. The incandescing conductor for an electric lamp formed of carbonized paper, substantially as described.

"4. An incandescing electric lamp consisting of the following elements in combination: First, an illuminating chamber made wholly of glass hermetically sealed, and out of which all carbon consuming gas has been exhausted or driven; second, an electric circuit conductor passing through the glass wall of said chamber, and hermetically sealed therein as described; third, an illuminating conductor in said circuit, and forming part thereof, within said chamber, consisting of carbon made from fibrous or textile material, having the form of an arch or loop, substantially as described, for the purpose specified."

The great question in this suit is whether the patent sued on is valid, so far as it involves a general claim for the use, in electric lamps, of incandescing carbon conductors made of fibrous or textile substances. If it is, the complaint must prevail. If it is not, the bill must be dismissed.

The claims of the patent (excluding the third claim, which the defendants do not use, and which is not involved in the case) may be summarized as follows: (1) A conductor of carbon made of fibrous or textile material, and of an arched form. (2) A conductor of carbon made of fibrous material in a hermetically-sealed chamber, without regard to form. (3) The combination of a conductor of carbon, made of fibrous or textile material in an arched form, and the glass chamber hermetically sealed, and deprived of carbon-consuming gas. The claim of the combination last named may be dismissed from consideration as a separate claim, because a glass chamber, hermetically sealed, for holding the light, has always been used and must necessarily be used in all incandescing carbon electric lamps. It was used by King in 1845, by Greener and Staite in 1846, by Roberts in 1852, by Konn in 1872, by Kosloff in 1875, and by others. Unless the patent is valid for the conductor of carbon, made of fibrous or textile material in an arched form, it cannot be made valid by combining such conductor with a glass chamber hermetically sealed.

We are equally of opinion that the giving of an arched form to the conductor was not new, and could not give to the claim any validity which it would not have as a broad claim of the conductor itself, made of carbon produced from a fibrous material. The arched or bent shape in incandescent conductors was applied in 1848 by Staite, to an iridium conductor, in 1858 by Gardiner and Blossom to a platinum conductor, and in 1872 by Konn to a carbon conductor. In the last case the conductor was inclosed (as it had to be) in a glass lamp or case filled with nitrogen or other gas incapable of supporting combustion. The carbon, it is true, is presented in a V-shaped form, but in a similar patent, applied for a few weeks afterwards claiming the same apparatus for the production of heat, the patentee very properly says, "It is evident that stems of other shapes may be used."

If the U or V-shaped form had not been given to carbons made in fibrous materials, for incandescent light, before Sawyer and Man adopted that form, it was merely an application by them of an old device to a new and analogous use. But the carbons used by Konn included charcoal as well as other carbons. He mentions graphite as preferable; but he claims the use of carbon generally.

As before stated, therefore, the patent must be construed as making the broad claim to the use, in electric incandescing lamps, of all carbons made of fibrous or textile substances. Is the patent valid for such a broad claim? The defendants contend that it is not; first, because no such invention was set forth in the original application, but was introduced for the first time more than four years after it was filed, and after the same material had been used by Edison, and claimed by him in an application for a patent; secondly, because Edison, and not Sawyer and Man, was really the original and first inventor of an incandescent conductor made of fibrous or textile material for an electric lamp; thirdly, because if Edison was not the first inventor the thing claimed as an invention was old, and neither of the parties was entitled to a patent for it.

The whole vegetable kingdom is composed of fibrous material and all carbon or charcoal made therefrom comes within the scope of the complainant's claim. Silk is fibrous or textile, and carbon made from silk thread is, therefore, within the claim. Mineral coal and the carbon produced in gas retorts are not included. Can it possibly be said, when we look at the history of the art of electric lighting, that carbon made from fibrous or textile material was never used for that purpose until Sawyer & Man used it in 1878? We think not. We do not propose to describe in detail the various English patents of prior date which have been adduced in evidence. The word charcoal, as well as carbon, is constantly used to define the material from which the conductors were made; and that word, in the English language *prima facie*, refers to carbon or coal made of wood. We cannot yield our assent to the ingenious theory of the complainant's counsel and some of their witnesses, that the word has come to have an artificial or technical meaning in this particular art, signifying gas or mineral carbon. We think that carbon made from wood or other vegetable material is generally intended. In King's patent of 1845, he says: "The nature of the invention consists in the application of continuous metallic and carbon conductors, intensely heated by the passage of a current of electricity to the purpose of illumination. . . . When carbon is used, it becomes necessary, on account of the affinity this substance has for oxygen at high temperature, to exclude from it air and moisture. To accomplish this in the most perfect manner, it should be inclosed in a Torricellian vacuum." He does not confine himself to any particular kind of carbon. It is true he does afterwards say "that form of carbon found on the interior of coal-gas retorts, which have long been used, is well suited for this purpose;" but his claim is general for "the application of metallic and carbon conductors intensely heated, etc.," and the use of wood carbon would have infringed the patent. Greener and Staite, in their patent of 1848, in describing how they prepared the carbon for the incandescing stems in their lamps, say: "We take a quantity of lamp-black or of charcoal reduced to powder, or of coke reduced also to powder, which has been purified, etc. The carbon thus highly purified we next bring into a state of great dryness and then convert it into solid prisms, or into cylinders both solid and hollow, etc." The charcoal here referred to is clearly wood charcoal. Roberts in his patent of 1852 says: "Another part of my invention consists of a mode of obtaining electric light by passing a current of electricity through a thin piece of graphite, coke or charcoal, or other infusible body, being a conductor of electricity, while it is inclosed in a vacuum of space not containing any oxygen or other matter which can cause the combination or destruction of it when brought into an incandescent state by the action of the current of electricity." This certainly refers to wood charcoal. We have already alluded to Konn's patent of 1872, in which he claims carbon stems generally, arranged as specified in the patent, for giving incandescent light. We may add that in the earliest experiments of Sir Humphrey Davy and others, on the effects of the electric current in producing light in various substances, charcoal was one of the most frequent articles used for that purpose. Long prior to 1878 it was a well-known fact in science and the arts that the transmission of the electric current through a pencil of charcoal interposed in a metallic circuit, would produce intense light; and that when this charcoal was guarded from contact with oxygen, in a vacuum or otherwise, it would not be consumed. This is fully verified not only in scientific writings, but by the statements found in several of the patents referred to. The great desideratum was to construct an apparatus and to discover a process which would make the light economical and convenient, of use for ordinary domestic purposes. We are clearly of opinion therefore, that neither Sawyer and Man, nor Edison can maintain any just claim to the exclusive use of charcoal generally in any form as an incandescing conductor in an electric lamp. This view of the subject is sufficient to decide the present case against the complainants. But there are other considerations which go to corroborate the conclusion to which we have come; which, however, we shall only cursorily examine.

It is very clear to us that in the original application for the patent sued on the applicants had no such object in view as that of claiming all carbon made from fibrous and textile substances as a conductor for an incandescing electric lamp. Nothing on which to base any such claim is disclosed in the original application. We have carefully compared it with the amended application on which the patent was issued, and are fully satisfied that after Edison's inventions on this subject had been published to the world there was an entire change of base on the part of Sawyer and Man, and that the application was amended to give it an entirely different direction and purpose from what it had in its original form. It is true that the last claim of the original was for "an illuminating arc," made of "carbonized fibrous or textile material." But this claim had special reference to the arched form of the conductor, rather than to the material of which it was composed. And this claim is the only expression in the application which even suggests any exclusive right to all vegetable carbons, or any invention or discovery in relation thereto. No advantage in the use of said carbon is anywhere alleged. The whole scope and purpose of the application related to the arched form of the conductor. A

subsidiary purpose was to claim carbon made from paper or paste-board. They say distinctly: "Our improvement consists in the employment of an incandescent arc of carbon in the circuit as the light-giving medium." "Carbon" generally, not any particular carbon. By an adroit amendment made in 1885, they say: "Our improvement relates more especially to the incandescing conductor, *its substance*, its form, and its combination with the other elements composing the lamp." The purpose of this amendment is obvious and needs no comment. After explaining the drawings, the original application goes on to say: "Our improved burner, or incandescent arc, consists of an arched-shaped or semi-cylindrical piece of carbon *A*, mounted on its clamps or supports in the usual well-known ways. We have tried carbonized paper covered with powdered plumbago, wood carbon or charcoal, and ordinary gas carbon. We have also used such arcs or burners of various shapes, such as pieces with their lower ends secured to their respective supports, and with their upper ends united so as to form an inverted V-shaped burner. We have also used arcs of varying contour; that is, with rectangular bends instead of curvilinear ones, but prefer the arched shaped, as the shadow cast by such a burner is less than that produced by other forms of burners. We have used such burners in close transparent chambers, in a vacuum in nitrogen gas and in hydrogen gas, but have attained the best results in a vacuum or attentuated atmosphere of nitrogen, the great desideratum being to exclude oxygen from the combustion chamber, as is well understood. The operation of our improved apparatus will readily be understood from the foregoing description." Then come the claims as follows: "First: Incandescing arcs for electric lights, made of carbon substantially as hereinbefore set forth. Second: Incandescing arcs of carbon in combination with the circuit of an electric light. Third: The combination substantially as hereinbefore set forth, of the circuit of an electric light, an incandescing arc of carbonized paper included in the circuit, and a closed transparent chamber in which the arc is inclosed. Fourth: An incandescing arc made of carbonized fibrous or textile material."

This is the whole of the original application, except the formal introduction. The arc is everything. The changes are rung on the arc. The fact is, that Sawyer and Man were unconscious that the arc was not new, and supposed that they could get a patent for it; but as their eyes were opened they changed about and amended their application and made the material of the conductor the great object—carbon made from fibrous or textile material. Compare the original with the amended application, as first stated in this opinion, and this purpose most obviously appears. The carbons mentioned in the original application are merely mentioned, by the way, to show that the arched form would apply to all kinds of carbon. "We have tried carbonized paper, covered with powdered plumbago, wood carbon and ordinary gas carbon." This is changed in the amended application to the words: "In the practice of our invention, we have made use of carbonized paper, and also wood carbon." The object of this change is manifest. In other parts of the amended specification, the importance of vegetable carbon as distinguished from gas carbon is dwelt upon. Thus, they say in a former paragraph: "Our improvement consists, first: Of the combination in a lamp chamber, composed wholly of glass, and described in patent No. 205,144, of an incandescing conductor of carbon, made from a vegetable fibrous material, in contradistinction to a similar conductor made from mineral or gas carbon, and also in the form of such conductors, so made from such vegetable carbon and combined in the lighting circuit within the exhausted chamber of the lamp."

The fact that the whole object of the application was changed is evinced by the correspondence of the parties. In a letter from Wm. B. Baldwin, one of the attorneys of the applicants for the patent, to his clients, the Electro-Dynamic Light Company (who then owned the interest in the invention), dated Jan. 8, 1880, he says: "I have this day prepared an application for patent of arched form of an incandescent carbon electric lamp made by Wm. E. Sawyer and Albon Man, as joint inventors, containing a request for the issuing of such patent to your company, etc. I will not make any alteration in the claims or specification of said patent, enlarging its scope beyond its intended purpose of covering the arched or angular form of the carbon used for incandescent electric lights." In a letter from Albon Man, one of the applicants for the patent to a Mr. Cheever, dated Dec. 12, 1880, he says: "I have received your two notes of 11th inst., inclosing letter from the Patent Office, advising Messrs. Baldwin, Hopkins and Payton of substitution of Mr. Broadnax, as attorney in *carbon arch matter*." This had relation to the application in question, Baldwin, Hopkins and Payton being the solicitors in the case, and Mr. Broadnax being substituted in their place. "Carbon arch matter" are words that could hardly be more suggestive.

As before stated, Edison had filed an application for a patent in December, 1879, about a month prior to the application in question, and in September, 1880, an interference was declared between the two applications. The controversy raised on this interference related principally to carbon made from paper, which Edison claimed in his application. The case was not finally decided until the beginning of 1885. Mr. Broadnax was examined as a witness in this suit, and testified as follows: "After the decision of the Commissioner of Patents of the interference, awarding priority of invention to Sawyer and Man, I resumed the prosecution of the application insisting upon our right to the claims that had been once rejected by the Examiner, among which was one for the U-shaped or loop carbon illuminant. My attention was then called for the first time by the Examiner to the British patent of Konn, in which is shown an arched-shaped carbon illuminant, and which, as I thought, anticipated broadly the claim for the U-shaped or arch-shaped carbon illuminant, and then in the discussion of the case with the Examiner my attention was called to the patentability of the fibrous carbon illuminant as such, on account of the properties such carbon possessed, which made it available for electric lighting above all other carbons." Being asked when this was, he said it followed soon after the decision of the Commissioner of Patents upon the question of priority, or as soon as he could, in the ordinary course, get the case before the Primary Examiner again; his best recollection was that it occurred in February, 1885.

This testimony of Mr. Broadnax, which is undoubtedly to be relied on, in connection with the letter just quoted, shows that the idea of claiming carbons made from fibrous and textile materials was an after-thought, and was no part of the purpose of the original application. The amendments relating to this new and broad claim were made afterwards, in February and March, 1885.

We are of opinion that the changes made in the application in this regard were not justifiable, and that the claim in question cannot be sustained.

There are other aspects of the case to which we might refer, which operate strongly against the claim of the complainants. We are not at all satisfied that Sawyer and Man ever made and reduced to practical operation any such invention as is set forth and claimed in the patent in suit. Their principal experiments were made in 1878 and perhaps, the beginning of 1879. The evidence as to what they accomplished in the construction of electric lamps is so contradictory and suspicious that we can with difficulty give credence to the conclusions sought to be drawn from it. We are not satisfied that they ever produced an electric lamp with a burner of carbon made from fibrous material, or any material which was a success. During the year referred to, 1878, and the beginning of 1879, they applied for and obtained 10 different patents (besides an English patent) on the subject of electric lamps; but not one of them contains a suggestion or hint of any such invention as is claimed in the patent in suit, which was not applied for until 1880. They all relate to lamps with straight pencil burners, generally of carbon, but without any preference given to one kind of carbon over another. The application for the patent in suit was not made until January, 1880, nearly or quite a year after all their experiments had ceased, and after the inventions of Edison had been published to the world. One cannot read the patents before applied for by Sawyer and Man, with all their detail of apparatus and proce s for constructing and managing the straight-stem conductors without distinction of carbons—apparatus and processes many of which would be needless in the lamp now claimed—without indulging some degree of astonishment at the pains and ingenuity gratuitously expended or wasted, if it was true that all the time they had in their possession a secret invention which would take the place of those complicated contrivances. The explanations made by the complainants for the delay in applying for the patent in suit fail to satisfy our minds that Sawyer and Man, or their assignees for them, have not sought to obtain a patent to which they were not legitimately entitled.

But suppose it to be true, as the supposed inventors and some of the other witnesses testify, that they did in 1878 construct some lamps with burners of carbon made of fibrous material and of an arched shape, which continued to give light for days, or weeks, or months; still, were they a successful invention? Would any one purchase or touch them now? Did they not lack an essential ingredient which was necessary to their adoption and use? Did they go any further in principle, if they did in degree, than did other lamps which had been constructed before? It seems to us that they were following a wrong principle, the principle of small resistance in an incandescing conductor, and a strong current of electricity, and that the great discovery in the art was that of adopting high resistance in the conductor, with a small illuminating surface, and a corresponding diminution in the strength of the current. This was accomplished by Edison in his filamental thread-like conductors, rendered practicable by the perfection of the vacuum in the globe of the lamp. He abandoned the old method of making the globe in separate pieces, cemented together, and adopted a globe of one entire piece of glass, into which he introduced small platinum conductors, fastened by fusion of the glass around them, thus being able to procure and maintain perhaps the most perfect vacuum known in the arts. In such a vacuum, the slender filaments of carbon attenuated to the last degree of fineness, may be maintained in a state of incandescence without deterioration, for an indefinite time, and with a small expenditure of electric force. This was really the grand discovery in the art of electric lighting, without which it could not have become a practical art for the purposes of general use in houses and cities.

It is unimportant to trace the various steps by which this great discovery was arrived at. It is well indicated and shown in Edison's patent applied for in April, 1879, and issued May 4, 1880, No. 227,229; and is more fully described in that which he applied for Nov. 4, 1879, and issued Jan. 27, 1880, No. 223,898. An extract from the latter will serve to explain the principles of this invention. Edison there says:

"Heretofore light by incandescence has been obtained from rods of carbon of one to four ohms resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed glass, cemented to a metallic base. The connection between the leading wires and the carbon has been obtained by clamping the carbon to the metal. The leading wires have always been large, so that their resistance shall be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon rod. The disadvantages of following this practice are, that a lamp having but one to four ohms resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that owing to the low resistance of the lamp the leading wires must be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented, hence the carbon is consumed, because there must be almost a perfect vacuum to render the carbon stable, especially when such carbon is small in mass and high in electrical resistance.

"The use of a gas in the receiver at the atmospheric pressure, although not attacking the carbon, serves to destroy it in time by "air washing" or the attrition produced by the rapid passage of the air over the slightly coherent highly heated surface of the carbon. *I have reversed this practice.* I have discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb, exhausted to one-millionth of an atmosphere, offers from 100 to 500 ohms res stance to the passage of the current, and that it is absolutely stable at very high temperatures; that if the thread be coiled as a spiral and carbonized, or if any fibrous vegetable substance which will leave a carbon residue after heating in a closed chamber be so coiled, as much as 2,000 ohms resistance may be obtained without presenting a radiating surface greater than three-sixteenths of an inch; that if such fibrous material be rubbed with a plastic composed of lamp black and tar, its resistance may be made high or low according to the amount of lamp-black placed upon it; that carbon filaments may be made by a combination of tar and lamp-black, the latter being previously ignited in a closed crucible for several hours and afterward moistened and kneaded until it assumes the consistency of thick putty. Small pieces of this material may be rolled out in the form of wire as small as seven one-thousandths of an inch in diameter, and over a foot in length, and the same may be coated with a non-conducting, non-carbonizing substance and wound on a bobbin, or as a spiral, and the tar carbonized in a closed chamber by subjecting it to high heat, the spiral after carbonizing retaining its form.

"All these forms are fragile, and cannot be clamped to the leading wires with sufficient force to insure good contact and prevent heating. I have discovered that if platinum wires are used, and the plastic lamp-black and tar material be molded around it, in the act of carbonization, there is an intimate union by combination and by pressure between the carbon and platina, and nearly perfect contact is obtained without the necessity of clamps; hence the burner and the leading wires are connected to the carbon ready to be placed in the vacuum bulb. When fibrous material is used, the plastic lamp-black and tar are used to secure it to a platina before carbonizing. By using the carbon wire of such high resistance I am enabled to use fine platinum wires for leading wires, as they will have a small resistance compared with the burners, and hence will not heat and crack the sealed vacuum bulb. Platina can only be used, as its expansion is nearly the same as that of glass.

* * * * * *

"I have carbonized and used cotton and linen thread, wood splints, papers coiled in various ways, also lamp-black, plumbago and carbon in various forms mixed with tar, and kneaded so that the same may be rolled out into wires of various lengths and diameters. Each wire, however, is to be uniform in size throughout."

The first claim of this patent is for an electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires, as set forth. The second claim is the combination of such filaments with the receiver made entirely of glass.

Of course the form of the filament in the receiver or globe may be varied at pleasure; it may be in the shape of a coil, or of a horseshoe, or it may be wound on a bobbin. All these forms are old. The principal and great thing described is the attenuated filament and its inclosure in a perfect vacuum. There may be a preference of material from which the filament is made. Practice will evolve all these collateral advantages.

We think we are not mistaken in saying that but for this discovery, electric lighting would never have become a fact. We have supposed it to be the discovery of Edison, because he has a patent for it. This may not be the case; it may be the discovery of some other person. But whoever discovered it, it is undoubtedly the great discovery in the art of practical lighting by electricity. We have given a more detailed account of it, in order to illustrate what we mean when we raise the question whether the claimed inventions of Sawyer and Man were ever successful. They may have made a lamp that would burn; but was it a success or was it a failure? Did it ever go into use? What was the object of all the experiments made by them and others? Was it not to make an electric lamp that could be successfully used by the public, and have a commercial value? Did they succeed in making such a lamp, or in finding out the principle on which it could be made? We do not so read the evidence.

The bill must be dismissed.